

# The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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## The Physical Chemistry of Lubricants

OF all the subjects upon which mankind is ignorant, and there are many, one of those that have been closely investigated but about which the most profound ignorance still exists is that of the chemical constitution and precise mode of action of lubricant oils. This somewhat surprising conclusion is the only possible one to be derived from the discussion on Mr. N. E. F. Hitchcock's paper on "The Production, Testing and Application of Lubricants," read before the Society of Chemical Industry last month. Lubrication is one of the basic discoveries upon which modern civilisation rests; without it the whole of our vaunted mechanism would stop. It is recorded that on the inner wall of the Egyptian tomb of Tehuti-Hetep (2000 B.C.) is a decoration showing methods of lubrication using olive oil for moving heavy constructional material. Deposits taken from the axle of a chariot of about 1400 B.C. give the first evidence of bearing lubrication. Nevertheless, it does not appear that much was known about lubrication until the 19th century was well under way, and it was certainly not until half way through that century that men began to produce industrial lubricants from petroleum products.

The practical selection of lubricants is as yet on an empirical basis. There are a number of known methods of testing, such as carbonisation, oxidation, viscosity, and so forth, which together would be expected to give the required knowledge and to enable the best lubricant to be selected for a particular purpose. It was shown in the discussion on Mr. Hitchcock's paper that although the methods of testing appear to have been developed to a high degree of standardisation, there is no agreement as to their interpretation. The state of knowledge in this branch of the subject was well illustrated by a comparison with horse racing. Each tipster has his reason for giving a different horse as the probable winner; in the same way each oil chemist might rely upon a different one of the numerous tests to back his opinion—and with an equal lack of certainty as to the result. It is fortunate that practical experience is able to overcome the theoretical difficulties of oil selection during the interim period while the scientists are catching up.

Lubrication is essentially a problem of liquid-solid interfaces. In a liquid-solid interface the surface layer is largely influenced by the shape of the molecule and by the presence of polar groups in the molecules forming the interfacial layer. For this reason a mono-molecular film of oil on the surface of water, for example, will be oriented so that the head of the

molecule, containing the polar groups, will adhere to the water surface and the tail, containing the non-polar groups, will extend vertically upwards. If there are forces on the surface of a metal like those on the surface of a liquid, polar bodies would take up oriented positions on the metal. It can be shown that solid surfaces exhibit these properties. Among other proofs are the absorption of gases by charcoal, the parallel growth of crystals on the surface of a large crystal of different composition (discovered by Beilby), and the adhesion of clean flat solid surfaces to one another. All these are evidence of external fields of force which can be increased by the incorporation of certain substances, known as catalysts, in the surface. It is thus likely, and is now considered as proved, that oil films behave on metals in the same way as they behave on liquids; they form a layer in which the head of the molecule "buries itself" among the surface molecules of the metal, while its tail waves in the air. This has been shown by several methods of proof, *e.g.*, the X-ray examination of fatty acids on mica; the fact that in the conversion of alcohols to aldehydes it is the  $\text{CH}_2\text{OH}$  group which is attracted to the copper catalyst; and also that when very thin layers of non-polar bodies are formed on optically true surfaces in contact, such surfaces show a minimum coefficient of friction immediately, whereas when polar bodies are used there is a considerable time-lag before the equilibrium state of minimum friction is obtained.

Although these general facts have been established we still know nothing of the constitution of lubricating oils, nor of what forms the head that adheres to the metal or the tail that waves in the air. One positive fact is that in a series of long-chain carbon atoms the greater the number of carbon atoms the less is the coefficient of friction. Lubricating oils consist chiefly of three main groups of hydrocarbons. Aromatic constituents are held to be responsible for the adhesive properties of oils, but for other reasons they are usually removed during refining. The naphthenic hydrocarbons seem to be the chief constituents of lubricating oil fractions, their properties depending on the number of rings present in the molecule. When these bodies possess side chains, however, they may exhibit very good lubricating properties, this observation being contrary to the general belief that the advantageous properties of oils are due to the presence of paraffin hydrocarbons only. Obviously much important research awaits those chemists who are specifically concerned with lubricating oils.

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## NOTES AND COMMENTS

## Tin Research in 1940

THE work of the Tin Research Institute during 1940 was directed largely to adapting tin to war industries, although progress in the more normal applications of the metal was maintained. A development mentioned in the Institute's annual report, which has just been issued, is a process, discovered in the laboratories of the Institute, by which the blackening of the insides of meat cans is prevented. The cans, or the tinplates from which they will be made, are immersed for a few minutes in a boiling solution, which is both alkaline and oxidising, so that an invisible film of oxide is produced upon them. In order to test the process, tinplates were treated in the Institute's laboratories, sent to South America, and formed into cans by the usual methods. They were then filled with corned beef, processed by the usual methods, and returned to England. Several weeks after being packed they were opened. The tinplate was still silvery and bright and had not blackened in the least, while a set of untreated cans were blackened and in some cases the surface of the meat was blackened. Full details of the process are given in Publication 104 issued by the Tin Research Institute. Another discovery of the Institute is the so-called "speculum" plating, a brilliant silvery plating obtained by the electrodeposition of a tin-copper alloy containing about 45 per cent. of tin; it is not quite so tarnish-resisting as chromium but it is more easily repolished. Unfortunately the commercial development of this plating process has been hindered by the war, but two plants have been installed in England and others are being discussed.

## New Bearing Metals

RESEARCHES showed that difficulties met with in soldering electro-tinned surfaces are due to the coating being too thin; the troubles disappear if the coatings are reasonably thick, and it is quite easy to make them so by using one or other of the modern electro-tinning baths described in handbook No. 92 "Electro-Tinning." Tin coatings are now being applied electrolytically to engine pistons and rings because they greatly reduce the wear during running-in and assist in retaining the lubricating film. The anti-friction qualities of tin are best-known in connection with the bearing-metals consisting mainly of tin with some antimony and small amounts of other metals. Work on these lines has greatly enlarged the range of bearing metals available, but it remains to carry out engine tests to decide which shall be used in particular

cases. The factors affecting adhesion of these bearings to the steel or bronze backing-shells are being studied and are now better understood. Efforts to find a better under-water bearing for ships have led to the discovery of an alloy of outstanding superiority, having a higher percentage of tin than is now used.

## Canadian Chemical Development

BIG strides are being made in the Canadian chemical and explosive programme, development of which is planned to cost \$105,000,000, and valuable aid in support of the British and American armament schemes is advancing by rapid stages. The Hon. C. D. Howe, Dominion Minister of Munitions and Supply, announced recently that eight of the 19 plants laid down in the programme have begun production and the others will come into line after varying intervals of time. Of the eight plants already at work, the output of two has exceeded their rated capacity, while the others have yet to be completed. One of these eight is an ammonia plant in Western Canada; four smaller undertakings will be devoted to other branches of chemical manufacture, namely, the production of red and yellow phosphorus, perchlorates, hexachlorethane, and activated carbon. The other concerns are to deal with explosives. Approximately 60 per cent. of the construction work on the programme, which is administered by the Allied War Supplies Corporation, a company entirely owned by the Crown, has been completed. By the middle of this year some 80 per cent. of the work should be finished, and by autumn the whole plan should be entire. At present 22,000 men are employed, of whom 4000 are engaged directly on production which will absorb increasing numbers during the next three months. The end of April was the scheduled date for the opening of two plants, one to produce a chemical used with a type of explosive. So the tale of progress continues. Two more large plants, both to be engaged on chemical work, will be ready for action by the midsummer. Less extensive works for the production of calcium carbide and another intermediate chemical should be producing by the end of June. The remaining plants are to come into operation later in the year; one is for the manufacture of hexachlorethane, as already noted, the remainder being occupied in the production of explosives.

## Power From Canadian Rivers

CANADA has long been recognised as a land of industrial abundance and among the latest evidence corroborating this comes some detailed news of the water-power resources of the country. The annual report of the Dominion Water and Power Bureau goes to show that a large proportion of the water-power resources of Canada still awaits development. Under conditions of ordinary minimum flow, a total of 20,347,400 h.p. are available and 33,617,000 h.p. for six months of the year. This corresponds to a potential turbine installation of about 43,700,000 h.p. On January 1 of this year the total turbine installation represented some 8½ million h.p. The importance of this source of power cannot be overestimated when it is remembered that Ontario and Quebec, both highly industrialised, are devoid of coal deposits, but instead of subsisting on foreign supplies they rely to a large extent upon water-power. Of the industries, about 90 per cent. of the mechanical equipment used in the manufacture of pulp and paper is operated by hydro-electric power. A million horse-power is estimated to be developed by the mining companies or else bought by them from the Central Electric Stations which are the chief producer of water-power. The principal mining areas of Canada, the gold and copper zinc-sulphide deposits in Northern Saskatchewan and Manitoba, and the coal and metallic ore fields of British Columbia—to mention only three—have ample and economically situated resources of water-power. Other industries, among which the chemical industry is one of the chief, draw a large amount of their power from the rivers either by means of purchases from the Central Electric Stations, which amount to almost 53 per cent. of the industrial power consumed in Canada, or through their own hydraulic installations.

# INTENSIVE SUPERPHOSPHATE PRODUCTION

## The Use of Elementary Phosphorus

by D. D. HOWAT, B.Sc., A.M.Inst.M.M., A.I.C., Ph.D.

AS in the last war, every effort is being made in this country to increase the supplies of home-produced food, but to attempt to raise crops from ground insufficiently fertilised may well prove a waste of time, money, and seed. Yet supplies of the essential superphosphate fertilisers are not abundant and lack of adequate amounts may form a bottle-neck in the production of home-grown food, at a time when the threat to British overseas communications makes it essential to cut to a minimum all quantities of imported material and to utilise to the very best advantage those materials which must be brought into the country.

For the past ten or fifteen years serious attention has been given in the United States to the position of domestic reserves of phosphate and, with a view to cutting loss of phosphate to a minimum, to the most efficient technological methods of treating the rock mined. Revolutionary changes in rock treatment methods have been effected, and superphosphates have been produced commercially with a content of available phosphorus pentoxide very much higher than would have appeared possible fifteen years ago. The newer methods of treating phosphate rock for the production of high-grade fertilisers developed in the United States of America may yet prove to be of more than academic interest to us here in Britain as we struggle to increase our supplies of home-produced food to counteract a submarine blockade of increased severity.

The two main sources of phosphate rock in the United States of America are the deposits in Florida and Tennessee. The actual mineral content of the rock is similar in the two places, but the physical characteristics differ considerably. The phosphate-bearing matrix in Florida is a gravel aggregate with fairly large and granular phosphate particles. In Tennessee, the phosphate occurs as a soft "brown rock" with a much higher percentage of fines.

### Economic Considerations

The market price commanded by phosphate being relatively low, all operations for concentration of the raw material or subsequent conversion to superphosphates demand careful study from the economic standpoint. Originally, only high-grade rock was mined and treated, but within the past ten to twelve years the adoption of flotation concentration has facilitated the mining and treatment of much lower-grade material. In concentrating phosphate rock two objects have to be achieved, first, the removal of adhering clay and silt from the phosphate gravel, and second, the separation of the fine phosphate from quartz particles by some method of selective concentration. Contamination of the phosphate particles with quartz becomes more pronounced in the size range finer than 14/20 mesh. Separation of the phosphate particles from the quartz may be effected by froth flotation using oleic acid as a collector. It has not been found economic to treat material finer than 150/200 mesh; this fraction is therefore separated and discarded before concentration. In the Florida field the loss of valuable phosphate in the discarded slimes was not very high, but the slimes from the "brown rock" of Tennessee were frequently found to contain over 30 per cent. bone phosphate of lime (B.P.L.).

There are two widely different markets for the output of phosphates: one, a large market, for low-priced relatively crude superphosphate for fertilisers, to which 80 per cent. of the phosphate output is directed; the other market, a smaller one, absorbing the remaining 20 per cent. of the output, for highly refined phosphoric acids for chemical, medicinal, and food purposes. In the older methods of superphosphate manufacture the ground rock was treated with dilute sulphuric acid, yielding a product with about 16 to 18 per cent. available phosphorus pentoxide. Newer methods developed within the past few years have proved this procedure highly inefficient.

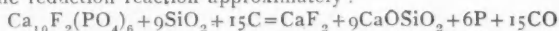
Although by these newer methods lower-grade ores have been treated, a greater recovery of phosphate has been effected than was possible by the older methods.

Smelting the ores either in blast furnaces or electric furnaces constituted the most important advance in the technology of superphosphate production. About ten years ago blast-furnace smelting began gradually to develop, while within the past five years the electric furnace has come to hold the most important place in the treatment of these ores. In 1868 the U.S. Department of Agriculture examined the possible development of the use of the blast furnace for the production of phosphate fertilisers. In 1924 the Victor Chemical Company embarked upon research into the possibilities of blast-furnace smelting. A large blast furnace was built at Nashville, Tenn., which proved so successful in operation that the company abandoned the use of the older sulphuric acid process completely, all the fertilisers being produced by the blast furnace. This is now the largest commercial blast-furnace plant in the world treating phosphate ores (see Fig. 1, p. 264).

### Development of the Electric Furnace

A still more important development had its origin in the demand for high-grade ferromanganese in the U.S.A. during the last world war. The Swann Chemical Company erected electric-arc furnaces at Anniston, Ala. These were used to capacity in the production of ferromanganese, but in the immediate post-war years were not able to earn depreciation costs. Taking note of the fact that phosphorus for chemical purposes had been produced at Niagara Falls in electric furnaces for many years, the Swann Company turned their attention to the smelting of phosphate ores as a possible employment for their furnaces. Long years and extended research were necessary before any measure of success was attained. In 1935, the Swann Company's interests were merged with those of the Monsanto Chemical Company, a new impetus being given to the investigation of electric-furnace smelting. In the same year, 2000 acres of phosphate land in the vicinity of Columbia were bought by the amalgamated companies. The furnaces at Anniston were found suitable for dealing with this ore and in the next step of the development programme three similar furnaces were erected at Columbia. In June, 1937, the first of these furnaces was put into commission, a tank load of elementary phosphorus, the first product of the new development, being shipped to the superphosphate plant at Anniston during the same month. This was an epoch-making time in the history of the phosphate industry and at the present time seven different companies are operating electric furnaces to smelt phosphate ores.

The general chemistry of the operation is very simple. The ore produced is really a more or less impure apatite with the approximate formula  $\text{Ca}_{10}\text{F}_2(\text{PO}_4)_6$ , the fluorine being an impurity very difficult to eliminate from the products obtained by the older "acid methods." The available phosphorus pentoxide in the ore varies from 12 to 14 per cent., the pure calcium phosphate containing 18.5 per cent. Smelting a mixture of ordinary crude ore, silica, and coke in a furnace reduces the phosphorus to the elementary form. Unless air is completely absent, varying quantities of phosphorus vapour oxidise to phosphorus pentoxide which may be absorbed in water or alkaline solution. This procedure has two very distinct advantages: (a) the amount of impurities is decreased, as only the vapour phase is collected and absorbed; and (b) a high concentration of phosphoric acid may be obtained in the absorbing solution. The following equation represents the reduction reaction approximately:



The slag produced, a solution of calcium silicate and fluorine, is tapped at regular intervals. The iron in the



charge being reduced from the oxides, practically all of it combines with phosphorus to form ferro-phosphorus carrying 25 per cent. phosphorus, this material constituting the second liquid product from the furnace. The gaseous products are a mixture of carbon monoxide and phosphorus pentoxide, which may be washed out of the fume with water or phosphoric acid in scrubbers followed by Cottrell precipitators. By suitable control of the condition in the scrubbers, various phosphoric acids may be produced. The greater part of the fluorine in the ore may be retained in the slag as calcium fluoride, only a small proportion escaping as silicon tetrafluoride, purification of the resulting acids being thereby simplified. The most important feature in efficient slag control is the maintenance of the correct ratio of lime to silica, a value which may vary from 0.83 to 1.28. In actual practice it has been found advisable to maintain the figure between 1.1 and 1.3, values lower than this being found to increase the fuel costs per unit of phosphorus pentoxide produced. The first research work on the lime/silica ratio was carried out by Dr. H. A. Curtis. On the assumption that silica merely acted as a fluxing agent, the amount of which should be reduced as much as possible, he tried high ratios, but results showed that while the slags could be liquefied in the electric furnace, pronounced volatilisation of silica occurred with contamination of the vapour products.

A certain amount of carbonaceous material is necessary for the reduction of phosphate to elementary phosphorus—roughly about 12 per cent. of the weight of the charge. The heat necessary to effect the reaction may be obtained either by the addition of excess coke to the charge, as in blast-furnace practice, or by the arc, as in electric-furnace practice. Until very recently the vapour products from the furnaces were burned, yielding phosphorus pentoxide and carbon dioxide, the phosphorus pentoxide being absorbed in scrubbers. The heat generated by the burning of the gases may be usefully employed in the blast furnaces to preheat the compressed air blast.

A number of important factors have modified the whole technology of phosphate ore smelting:—

1. *The availability of cheap electric power from the T.V.A.*—From the hydro-electric schemes controlled by this body, power is available at rates as low as 0.185d. per kWh. These cheap rates have led to great advances in the development of electric furnace smelting.

2. *Direct smelting of unwashed rock.*—Before 1936 the customary practice, even in electric-furnace smelting, was to use

ores gave fines carrying in some cases over 30 per cent. B.P.L., flotation concentration being difficult and expensive. As the technique of furnace operation improved investigations showed that it might be more economical to smelt considerable quantities of unwashed Tennessee ore. Flotation concentrate and unwashed material were blended together in the proportion required to give the correct lime/silica ratio, a self-fluxing charge being produced. Alumina did not prove to be a difficult problem, as with the percentages commonly found in this area it may replace silica in the slag in the proportion of one part of alumina to 0.59 parts of silica. This treatment permitted a much higher recovery of the available phosphate in the rock. In the Estes Bend region, where both Monsanto and T.V.A. are mining, about 55 per cent. of the output is smelted directly, while the remainder is washed. The combined recovery of the available phosphate by this method is well over 80 per cent., a figure which could not be approached by even the most efficient combination of concentrating and washing processes at present available.

3. *The treatment of unwashed fines by sintering or nodulising.*—Sintering or nodulising methods were devised to treat the unwashed fines. Monsanto carried out the pioneer work along these lines. The process has now become fairly well established, being employed for the treatment of charges both to the blast furnace and electric furnace. Several benefits have followed from the adoption of the sintered charge: more efficient mixing of the constituents, more rapid melting down, better slag control, decreased heat consumption for melting and reduction, and partial elimination of such impurities as sulphur and fluorine.

4. *The exclusion of air from the furnace.*—By the adoption a very tight furnace construction so that no air can enter, the reduced phosphorus remains in the vapour in the elementary form and may be condensed and collected in suitable receivers. This process offers an additional means of purifying the phosphorus, cuts down the volume of gases which must be burned, allows the utilisation of the carbon monoxide in the nodulising or sintering plant, and makes it possible to transfer the phosphorus in bulk to localities where it may be transformed to phosphates or other chemical compounds.

### Types of Furnace Employed

Seven different firms have installed and built electric furnaces. A rough idea of the construction and operation of these furnaces may be obtained from two papers by Curtis and co-workers. Originally, both rectangular and circular section furnaces were tested. The rectangular furnace was 9 ft. 8 in. by 19 ft. 3 in. with a maximum depth of 8 ft. below the roof arch. The bottom and sides of the furnace to a level above the slag line were constructed of heavy carbon blocks. Three 30-in. carbon electrodes were suspended through the roof of the furnace at 5 ft. 9 in. centres, being arranged in a straight line. The electrodes were made up in 110-in. lengths with inside screw threads in each end, lengths being coupled together by an outside screw. The charge was fed into closed hoppers around the electrodes, hoppers being rotated to effect even distribution of the charge. The gases are withdrawn from outlets at each end of the furnace. These furnaces drew 6000 kW and produced 10 tons of phosphorus vapour daily. A 15 foot diameter electric furnace was also employed, the construction being similar to the one described above, except for water-cooling in the steel shell. The three 30-in. carbon electrodes were spaced at the corners of an equilateral triangle, 4800 kWh being consumed per ton of  $P_2O_5$  charged.

In a very recent installation, using dried coke and nodulised phosphate rock fines, four rectangular electric furnaces have been installed. Each furnace is fitted with a condenser to collect the phosphorus vapour and three 30-in. carbon electrodes, power supply being 5500 kW. To the charge of nodulised fines, containing 24.5 per cent. phosphorus pentoxide, 282 lb. per ton of coke are added, 4.04 tons of nodules being smelted per hour. Each furnace is estimated to produce nearly 11,000 tons of phosphorus per year with a total annual consumption of nearly 200 million kWh. At the stipulated price of 0.185d. per kWh, the power cost is almost £10 per ton of phosphorus

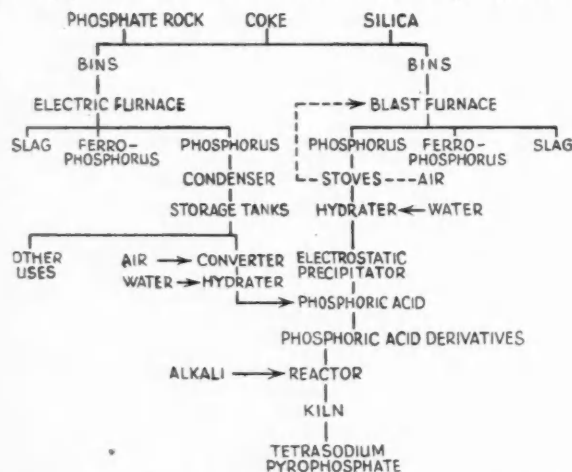


Fig. 1. Flow-sheet showing manufacture of phosphorus and phosphoric acid derivatives by smelting phosphate rock in electric furnaces or blast furnaces. Actual process used by the Victor Chemical Company.

washed phosphate rock or concentrates. In Florida the granular character of the phosphate rock made the production of high-grade concentrates easy. In Tennessee the more friable



produced. The consumption of carbon electrode is 16.1 lb per ton of  $P_2O_5$  in furnace charge. Recoverable carbon monoxide from the phosphorus condensers averages 750 million cu. ft. per year, 4770 tons of 25 per cent. ferrophosphorus and 96,000 tons of slag being produced annually from the total of 126,350 tons of nodulised charge.

Attached to each furnace is a phosphorus-condensing unit, the gases passing first through a brick-lined steel tower, fitted with water sprays, then through smaller coke-packed towers serving as entrainment separators. After the removal of the phosphorus the residual gases from the condensers, carrying over 90 per cent. carbon monoxide, are pumped to the adjacent raw-materials plant where they are used to heat the nodulising kiln or to ignite the sinter machine charge.

### Handling and Storage of Phosphorus

The mixture of liquid phosphorus and water from the condensing system is pumped to a thickener in which the phosphorus, together with any solid material, separates from the water, the overflow being collected in a small tank and subsequently recirculated to the condenser sprays. A steel tank, 40 ft. in diameter, lined with lead and acid-proof brick, and fitted with a bronze raking mechanism, is used for thickening. The liquid phosphorus is pumped to underground concrete tanks lined with acid-proof brick. Eight of these, each 10 ft. square and 8 ft. deep, have been built, a central launder being provided to withdraw any excess water carried over with the phosphorus. The tanks are closed with tight stainless steel covers, floats indicating the level of the phosphorus. Steam coils are immersed in the tanks and all pipes carrying liquid phosphorus are constructed of bronze and wound round with steam copper piping, and completely enclosed in a 1-in. thickness of magnesia pipe insulation. From the tanks the liquid phosphorus is pumped by vertical submerged pumps driven by motors above the cover level. The Monsanto Chemical Company pump the elementary phosphorus into tank cars, by which it is transported from the smelter at Columbia to the fertiliser manufacturing plant at Anniston, Alabama.

### Calcium Metaphosphate Fertilisers

Dr. H. A. Curtis, the chief chemical engineer, has described some of the important developments made by the T.V.A. in producing fertilisers with a high content of available phosphorus pentoxide. Soil erosion, a pressing problem in the district, has been under consideration by the T.V.A. for some time. The employment of special types of fertilisers may offer at least a partial solution of the problem, one important section of the T.V.A. research organisation being directed to this purpose. At Wilson Dam, Ala., a full-scale plant has been erected to produce a calcium metaphosphate fertiliser. When tested by the neutral ammonium citrate test, practically the entire phosphorus pentoxide content, amounting to 65 per cent., is found to be available. The value of the compound as a fertiliser has been tested in many ways and it appears to be highly satisfactory.

The principle of manufacture of the compound is the burning of elementary phosphorus to phosphorus pentoxide, which then passes over lump phosphate rock, combining with it to form the metaphosphate. The temperature is sufficiently high to melt the compound, which flows from the furnace as a sticky viscous fluid, and is collected outside and allowed to solidify. The projected plant, described in a paper by Curtis, is composed of two separate units, one for the reduction of the phosphorus from nodulised rock fines by electric furnaces, the other comprising the plant for volatilising and burning the phosphorus, the absorption towers filled with lump phosphorus rock, and the collecting tanks for the metaphosphate. The existing plant contains only the second unit, elementary phosphorus being brought in from other sources.

The elementary phosphorus is stored in underground concrete tanks, each of 20,000 lb. capacity, lined with acid-proof brick and provided with steam heating coils. From the tanks the phosphorus is pumped by submerged vertical centrifugal pumps through a pipe loop from which a metering pump takes the requisite quantity for delivery to the burners. The burner,

in the form of a nozzle, disperses the phosphorus into the combustion chamber by a jet of high pressure air. The combustion chamber is divided into a horizontal and a vertical section, the former being necessary to burn the phosphorus, which contains

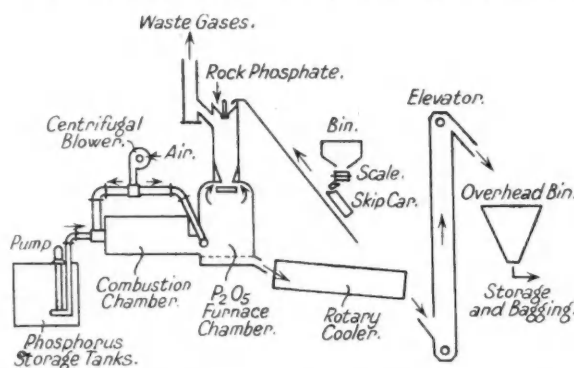


Fig. 2. Flow-diagram for manufacture of calcium metaphosphate

considerable quantities of water and solid impurities. Secondary air is fed to the vertical combustion chamber to complete the oxidation of the phosphorus, which is completely volatilised, but only partially burned in the horizontal section. Air, supplied from centrifugal compressors, furnishing 2500 cu. ft. of air per minute at a pressure of 2 lb./sq. in. is fed tangentially into the horizontal section of the combustion chamber. The amount of the phosphorus burned in the horizontal section of the combustion chamber should be merely sufficient to maintain a temperature that will ensure the volatilisation of all the remaining phosphorus and of any residual water, a temperature of about 980° C. being required. Secondary air, admitted to the vertical section of the combustion chamber, completes the oxidation of the phosphorus vapour, ensuring that the gas enters the absorption tower at a temperature of 1035° to 1050° C. From 600 to 900 lb. of phosphorus may be burned per hour, the quantity being controlled by varying the speed of the metering pump. By this means the phosphorus is completely burned and gases carrying  $P_2O_5$  vapour pass up through the absorption tower. Lump rock phosphate lying between 3 in. and 3/4 in. is weighed and delivered by skip hoist to the bell-top of the absorption tower—a cylindrical chamber shaped as indicated in Fig. 2.

Calcium metaphosphate is formed in the tower by the lump rock phosphate absorbing the phosphorus pentoxide. At the temperature obtaining in the tower the compound forms as a viscous liquid which flows down, collecting in a pool in the bottom of the vertical section of the combustion chamber. Withdrawn periodically from the combustion chamber, the liquid is allowed to solidify in a slowly rotating drum, water-cooled on the outside. A layer of metaphosphate adheres to the inside walls and, on solidification, the cake breaks away, forming a dry, flaked product. The material is crushed in hammer mills in circuit with screws and is bagged for shipment.

The rock in the absorption tower is supported by making a constriction in the wall and by the construction of a perforated arch. Operating conditions are very severe at the constriction, the high gas velocity and the high temperatures together with the corrosive action of the gases and of the liquid metaphosphate causing very severe corrosion of the refractories. The supports shown in the flow-diagram are constructed of cast refractory material, in which water cooling pipes are embedded. The cast material, containing 20 per cent. lumnite cement and 80 per cent. calcined flint clay grog, is faced with zircon refractory blocks, the most corrosion-resistant material found up to date. The lower part of the tower in which the liquid metaphosphate collects is lined with "Corhart" refractories, the outside steel shell being water-cooled.

At the start of operations the combustion chamber is brought up to the necessary temperature by burning oil, phosphorus

being fed to the burner only when the temperature is sufficiently high to cause rapid ignition and evaporation of the unburned fraction of the amount brought to the burner. The pressure in the combustion chamber is about 20 in. W.G. Decrease in pressure indicates the formation of channels through the lump rock in the tower, while an increase in pressure reveals that temporary blocks, formed as the metaphosphate freezes if the temperature falls too low, are hindering the free passage of the gas through the absorption tower. Under normal conditions about 98 per cent. absorption takes place in the tower, about two tons of metaphosphate being produced per hour by the combustion of 600 to 900 lb. of elementary phosphorus.

### Production Costs

Curtis makes out a detailed statement of the economic and financial aspects of the production of these fertilisers with high phosphorus pentoxide content. The annual requirements of the proposed fertiliser plant are 126,350 tons of phosphate nodules for the phosphate reduction furnaces and 28,600 tons of lump phosphate rock for use in the production of metaphosphate. About 51,400 tons of metaphosphate containing 65 per cent. phosphorus pentoxide are produced annually together with 4770 tons of 25 per cent. ferrophosphorus and 750 million cu. ft. of carbon monoxide gas. Electric power amounting to 191,200,000 kWh per annum is required and the estimated cost of this \$537,840, or 2.81 mills per kWh, or approximately 0.14d. per kWh (taking a dollar as equal to about 50d.). Buying electric power at approximately from the T.V.A., the total production costs are \$38.20 per ton of metaphosphate. Credits of \$6.93 for the sale of ferrophosphorus and \$0.73 for the sale of carbon monoxide gas reduce

the figure to \$30.54 per ton. Comparing the figures for bulk superphosphate (16 per cent. phosphorus pentoxide—prepared by the acid process), superphosphate (50 per cent. phosphorus pentoxide—produced by the action of phosphoric acid), and calcium metaphosphate (60 per cent. phosphorus pentoxide), Curtis shows that in the case of a farmer 200 miles from the producing unit the total cost per ton of available phosphorus pentoxide is \$110.55, \$89.65 and \$80.76 respectively, the economic and financial factors thus favouring the new fertilisers. One feature of note in the costs is the allowance of nearly \$7 per ton for ferrophosphorus. This material is valuable in the steel industry, affording a method of controlling the phosphorus content of certain types of sheet steel. When offered in limited amounts it will fetch a good price, but with the extension of electric smelting of phosphate ores this market may easily become saturated and development of methods of using ferrophosphorus as a source of phosphorus pentoxide in the manufacture of fertilisers may be necessary.

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## U.S. Mineral Production for 1940 Increase Due to Armament Demands

THE total value of all mineral products of the United States in 1940 increased 15 per cent. over 1939, according to estimates based on preliminary data collected by the Economics and Statistics Branch of the Bureau of Mines. The estimated value of \$5,600,000,000 for mineral products in 1940 is the highest since 1929. The increase in value is partly attributable to the general rise in the price level of minerals, but substantial increases in the volume of production of both metals and non-metals were common. By the end of 1940 the demand for minerals, largely as a result of the defence programme, reached heights unprecedented in recent years. The estimated total value of metallic products in 1940, amounting to \$1,650,000,000, was 28 per cent. above that of 1939, and was exceeded only during the war years, 1917 and 1918, and in the post-war year 1920 when prices were abnormally high. Non-metals likewise recorded substantial increases, but did not keep pace with the trend in metals. Mineral fuels advanced only 10 per cent., and their total value—\$3,100,000,000—has been exceeded several times in the past two decades. The value of other non-metals reached \$850,000,000, the highest since 1930, but substantially below the level of the twenties when construction activity was far above any subsequent year. The increase in industrial activity largely in the defence industries, and in some instances the procurement of stock piles of strategic minerals, stimulated production of copper, lead, zinc, aluminium, iron, ferro-alloys, manganese, tungsten, mercury, titanium, cadmium, uranium, and vanadium.

### Zinc Price Stabilised

With the steel industry establishing a high record, the production of iron ore, except for the years 1916 and 1917, also reached the highest level to date. The iron ore shipped from mines in 1940 is estimated at 74,969,000 long tons valued at \$191,734,000, an increase of 37 per cent. in quantity and 21 per cent. in value over 1939. The value of pig iron ship-

ments increased about 35 per cent., ferro-alloys more than 35 per cent., and manganese ore about 45 per cent. Smelter output of copper from domestic ores increased 27 per cent. in quantity and 38 per cent. over the same period of time in value. The value of the smelter output of zinc from domestic ores is estimated at \$76,518,000, an increase of 50 per cent.; the demand exceeded the output and producers' stocks reached the lowest level since 1925. To avoid a runaway market, therefore, the price was stabilised at 7.25 cents in September, 1940. The value of output of refined lead increased about 16 per cent., but did not keep pace with demand, and refinery stocks at the end of 1940 were 60 per cent. lower than at the end of the previous year.

### Aluminium Record

Primary aluminium production exceeded the record established in 1939 by 26 per cent., but the total value increased only 17 per cent. This drop in price was contrary to the general trend of metal prices. The extremely high price of mercury during the year stimulated producers virtually to double their output in 1940, while the total value more than trebled. The intense activity in machine-tool industries is estimated to have resulted in an increase in domestic production of tungsten amounting to almost 20 per cent. The production of gold and silver increased 5 and 10 per cent. respectively; other metals showing substantial increases in total value of output were magnesium, cadmium, tantalum, titanium, uranium, and vanadium. Only three metals registered decreases in 1940; the total value of platinum production dropped slightly, molybdenum declined about 25 per cent., and chromite even more. The drop in molybdenum was due largely to the decline in exports following the establishment of the moral embargo at the close of 1939 and the export licensing proclamation of July 2, 1940. Of the non-metals, the sulphur output increased, as did that of fluorspar, feldspar, sheet mica, potash, tripoli, diatomite, etc.

# British Chemical and Dyestuffs Traders' Association

## Cordial Relations with the Government

THE eighteenth annual general meeting of the members of the British Chemical and Dyestuffs Traders' Association, Ltd., was held at the Great Eastern Hotel, London, E.C.2, on May 7, Mr. A. F. Lawson (the chairman) presiding. Following the adoption of the audited accounts, Mr. Lawson, in the course of his report on the year's work of the Association said:—

"The past year has been a particularly active one for the Association and a considerable amount of work was undertaken in dealing with such matters as the import and export licensing restrictions, controls, war risk insurance, purchase tax, sources of supply and questions of interest to chemical traders. Frequent bulletins were issued enabling members to be well informed about emergency orders and regulations which might affect their trading activities. Consultations between the Association and the Government Departments were often necessary and the degree of co-operation attained is very gratifying.

### Regulation of Supplies

"With the development of the war situation it became necessary to impose further restrictions on home and overseas trade and to regulate supplies of raw materials needed for essential industries. Taking the chemical industry as a whole, however, production and distribution were well organised to meet the demands necessitated by the war effort, although for certain chemicals a system of control was introduced under which supplies are allocated on a rationed basis or for special requirements. I know I am voicing the opinion of all members when I say that in normal times we are opposed to controls in any form, but in times of national emergency exceptional measures are called for and the merchant community has already shown a readiness to adapt itself to a system of control provided the machinery is adequate to achieve the intended object. So far as chemicals are concerned distribution throughout the country has been maintained at a high standard of efficiency.

### Work of the Export Group

With reference to the subject of imported chemicals the entire range of K.I.D. products has now been brought within the scope of the licensing regulations. More stringent licensing was necessary for financial and shipping considerations, considerations which we know to be of vital national concern. The arrangements made by the Board of Trade Committee for expediting the procedure for dealing with applications for import licences have proved very satisfactory and delays have largely been eliminated. In regard to export trade it is now twelve months since the Chemical Traders' Export Group was inaugurated and I know the group has performed some very useful work. The overseas trade obtained by chemical merchants in the first six months of 1940 was quite substantial and but for overriding considerations which necessitated the curtailment of certain exports further progress would be recorded. The selective policy which the Board of Trade has applied to exports places limitations on the efforts of export selling organisations, who are now faced with the problem of maintaining trade connections in markets which will be of supreme importance to this country in the post-war period.

"There was a period when the delay in the settlement of claims made under War Risk Commodity Insurance policies appeared to be unreasonable and the Association made appropriate representations to the Board of Trade and at the same time submitted a proposal that when a claim was established in principle part payment should be made immediately, leav-

Mr.  
Victor Blagden,  
re-elected  
President of the  
B.C.D.T.A.



ing the final settlement to be adjusted in due course. As members are aware the Board of Trade subsequently made arrangements on the lines proposed and this is a considerable help to those firms who are unfortunate enough to incur a severe loss."

After referring to the limited number of items in the chemical trade affected by the Purchase Tax, Mr. Lawson continued: "I now wish to refer to a problem which concerns the majority of our members. It is becoming increasingly difficult to replace experienced employees who have been called up for service with the Armed Forces. The policy followed by the trade has been to give every assistance to those employees who desired to volunteer and at the present time not a few traders are carrying on with depleted staffs. Now that the later age groups have been called to register many firms are faced with the possibility of losing the only men remaining with the requisite experience for handling the distribution of chemicals. Under the revised Schedule of Reserved Occupations and Protected Work application may be made to be registered in the list of protected establishments and the application is required to be supported by evidence of Government work. Since the bulk of the chemical trade to-day is limited to raw materials required in the war effort it is obvious that the firms engaged in the distribution of these materials should be safeguarded. The Association has stated the position to the Ministry of Labour and National Service and I do not doubt that in appropriate cases the principle of 'protected' work will be applied."

In conclusion, the chairman referred to the Association's cordial relationship with Government departments and paid tribute to the officials of the Ministry of Supply, H.M. Customs and Excise and the various departments attached to the Board of Trade with whom frequent consultations have been necessary. The help of the Association had been valuable in dealing with many day to day problems members individually have come up against as a result of the existing complex conditions. Finally Mr. Lawson thanked the President and Members of the Executive Council for their loyal support and the report was adopted with expressions of warm approval.

### Officials of the Association

The following were then elected to serve as officials of the Association for the ensuing year: President, Mr. VICTOR BLAGDEN; vice-president, Mr. S. J. C. MASON; chairman, Mr. A. F. LAWSON; vice-chairman, Mr. G. S. BACHE; hon. treasurer, Mr. W. BECKLEY; hon. auditor, Mr. B. C. HUGHES; executive council, Mr. C. H. WILSON (Cole and Wilson), DR. E. J. PARRY, F.I.C., F.C.S., Mr. H. GILLIAT (E. G. Jepson and Co.), Mr. W. S. ADPAR JONES (C. Tennant, Sons and Co.), and Mr. E. ARNOLD (R. W. Greeff and Co.).



## British Association of Chemists Annual Meeting

THE annual general meeting of the London Section of the British Association of Chemists was held at the Café Royal, London, W., on May 3. The report for the past year showed a membership of 1111, which represents an increase of 95 during the year, but it was urged that every effort should be made to increase the numbers still further. The committee expressed regret that the activities of the section during the past year had been somewhat curtailed, but many subjects had been closely debated and resolutions put forward to the Council. During the year definite steps had been taken which, it is hoped, will result in closer co-operation between the various chemical societies, but as the matter is still *sub judice*, it was impossible to give further details. Two groups are in course of formation in the section, one in the Bristol area and one at Tonbridge.

Mr. W. C. Peck was elected chairman for the coming year; Miss W. Wright and Mr. W. Littlejohn were re-elected as joint hon. secretaries, and Mr. H. Langwell was re-elected hon. treasurer; Mr. F. S. Baxter, Mr. G. H. Clarke, and Mr. K. Mackenzie Richards were chosen to fill vacancies on the committee.

The retiring chairman, Mr. S. Linfoot, thanked the President of the Association, Prof. F. G. Donnan, F.R.S., for his constant attention to the affairs of the Association. He spoke with satisfaction of the fact that Dr. A. E. Dunstan was President-Elect of the Association, a man who, he said, would bring a new viewpoint to the work of the Association and one whose activity would be invaluable. The chairman paid a tribute to the work of Mr. J. P. B. Harrison, who not only initiated the Unemployment Scheme of the Association, but has acted as chairman of the committee since its inception some 20 years ago. Miss Wright succeeds Mr. Harrison as chairman of the Unemployment Special Purposes Committee. Mr. Price presented a silver tea-set to Mr. Harrison, as a slight recognition of his work for the Unemployment Scheme. Mr. Harrison expressed his appreciation of the gift and thanked all those who had helped the work forward in face of the fact that the Council of the Association was at first rather chary of the idea. He added that he himself could only claim a small share of the credit for what had been accomplished.

Arrangements were made to hold meetings during the year to discuss the many problems affecting chemists which arose out of war conditions.

## Colorimetric Estimation of Nitrate Ferric Chloride as Standard

VARIOUS methods have been suggested from time to time for the colorimetric estimation of nitrates, the most commonly employed method for the estimation of nitrates in minute quantities being that which makes use of the phenol sulphonic acid. Recently an alternative method was developed by Murty and Gopala Rao, who employed the  $\alpha$ -naphthol sulphonic acid reagent. Its usefulness has been extended by Murty to the analysis of nitrate in the presence of nitrite.

In the  $\alpha$ -naphthol method the standard for the comparison of colours has to be prepared each time the analysis is carried out. This is necessary on account of the fact that the depth of the yellow colour changes on keeping for more than six hours. Attempts were therefore made to find out a suitable permanent standard. G. V. L. N. Murty (*Proc. Ind. Acad. Sci.*, 1941 (A), 13, 2, 118) has now shown that a solution of ferric chloride (0.08 N) can be satisfactorily employed as a permanent standard in the colorimetric estimation of nitrate by the  $\alpha$ -naphthol sulphonic acid method. The close resemblance of the colours of the ferric chloride and the corresponding standard nitrate solution was established by analysing them by means of the Keuffel and Esser colour analyser. The colour of the ferric chloride solution is quite stable, which enables it to be used as a permanent standard.

## New Control Orders Mercury Prices and Supplies

THE Ministry of Supply announces that the Control of Mercury (No. 5) Order has been amended by the Control of Mercury (No. 6) Order, which came into force on May 3. The maximum selling prices of mercury salts fixed by the No. 5 Order remain unchanged, but maximum selling prices are now fixed for mercury metal, both in bottles of 76 lb. and in smaller quantities. The metal has hitherto not been subject to price control.

The maximum price for quantities of over one bottle, but less than eleven bottles, is £48 15s. per bottle, and for larger quantities £48, ex sellers' premises in both cases. There are higher prices for lots of under one bottle and for redistilled grades.

Notice is also given that the Ministry of Supply is prepared to sell quicksilver (commercially pure virgin mercury) to buyers approved by them and applications should be made to the Raw Materials Department (Mercury Control), Ministry of Supply, Warwick, from whom order forms are obtainable. No applications will be entertained by the Ministry except for eleven or more standard bottles each containing 76 lb. nett; inquiries for smaller quantities or for quantities not comprised in standard bottles of 76 lb. or for redistilled mercury should be addressed to mercury dealers in the normal way, as at present. Applications should only be made in respect of requirements for current consumption and a cheque in payment of the full quantity applied for should be sent with the completed order form; refund will, of course, be made in respect of any quantities the supply of which is not approved. The mercury will be sold until further notice by the Ministry at the price of £47 15s. per bottle ex warehouse in U.K.

## Borax and Boric Acid

Among other items, the Export of Goods (Control) (No. 18) Order (S.R. and O. 1941, No. 592), issued by the Board of Trade, which comes into force on May 14, specifies that borax and boric acid, the exportation of which was previously controlled to all destinations, may now be exported without licence to destinations within the British Empire.

## Petroleum Consumption

The Secretary for Petroleum has made the Petroleum Order, 1941 (S.R. and O. 1941, No. 546), which came into force on April 25. The Order contains powers for controlling the consumption of "liquid fuel" and in future no person may use by burning any "liquid fuel" in contravention of a direction given by the Secretary for Petroleum. For this purpose "liquid fuel" means (a) gas oil, diesel oil, fuel oil, and any similar product of petroleum or shale, and (b) any crude or dehydrated coal tar, carburetted water-gas tar, producer-gas tar, pitch, creosote, blends of creosote and pitch, and any of the oils known as coal-tar oils. The new powers will be exercised immediately to secure the increased substitution of home-produced tar oils for the imported petroleum products at present used.

Strikingly entitled "Revolution," the latest leaflet issued by the PASCALL ENGINEERING CO., LTD., West Central Street, London, W.C.1, provides handy reference for chemical manufacturers in search of efficient equipment. Short descriptions are provided of centrifugal mills, screen sifters, sieve vibrators, dry batch mixers, and the new "Monitor" triple roll mill, and reference numbers are given of more detailed lists available.

THE BRITISH AMERICAN OIL CO. at Toronto has announced the construction of a new plant with an annual capacity of 10,000,000 gal. of lubricating oils at a site on the lake shore, west of Toronto. This expansion will materially increase other fractions produced at this point. The estimated investment is \$3,000,000. The financing, it is understood, will be done in part with U.S. funds which will not require any transfer of Canadian money. The new plant will be producing by December.

## The Hydroforming Process\*

### Commercial Plant in Operation

THE most recent addition to the growing family of catalytic petroleum refining processes is the hydroforming process. The first commercial hydroforming plant was placed in operation recently at the Texas City refinery of the Pan American Refining Corporation. It is capable of re-forming about 7500 barrels per day of 40 to 45-octane heavy naphtha to an 80 per cent. yield of about 80 A.S.T.M. octane petrol. The unit is designed to take all the low-octane heavy naphtha produced from the two largest cracking units in the world—capacity about 40,000 barrels per stream day each—in addition to small amounts of heavy naphtha from miscellaneous crude topping operations.

Although the process involves a reaction in the presence of hydrogen, it is not closely related to the hydrogenation process. Hydrogenation reactions involve addition of hydrogen to hydrocarbon molecules, whereas the net effect of the hydroforming process is to dehydrogenate. Part of the hydrogen thus produced is recirculated with the fresh feed to control the rate and extent of the dehydrogenation reaction. The most important property of the hydroforming catalyst is that it causes ring-closure to occur along with dehydrogenation, so that the product contains only a small quantity of aliphatic unsaturates and is unusually stable.

While design of the plant presented some difficult engineering problems, the process flow is relatively simple. The fresh feed, consisting of 40 to 45-octane heavy naphtha, is preheated by heat exchange with hot reaction products and sent to a combination naphtha and recycle gas preheater furnace. A hydrogen-rich recycle gas stream from a gas separator, also preheated, is sent through a separate coil in the preheater furnace which heats it to a high temperature. The two streams issuing from the furnace are mixed and sent to the catalytic reactors which are under substantial pressure.

### Use of the Recycle Gas

The hot reaction products leaving the catalytic reactors are partially cooled by heat exchange with cold naphtha feed and other products, then cooled to normal temperature, and sent to a gas separator. Part of the gas from the separator is used as recycle gas, and the balance goes to the refinery fuel system. The liquid from the gas separator is pumped to a stabiliser tower where the last traces of gas are removed, and then to a re-run tower where a small amount of heavy polymer is removed. The product from the re-run tower is sent to storage from which it is blended into finished motor spirit.

During the hydroforming reaction, a small amount of coke is deposited on the catalyst, gradually decreasing its activity. The plant has two large catalytic reactors, which are in service alternately—one on stream and one off for reactivation. In designing the plant, thermal cracking of the naphtha before it contacts the catalyst was avoided because this decreases both the yield and the octane value and results in excessive coke deposition. Design of the recycle gas stream and reactivation systems was complicated from an economic standpoint because, for any given octane level, coke deposition is a function of the amount and the hydrogen concentration of the recycle gas.

Operation of the reactivation system is entirely automatic and is controlled through a time-cycle mechanism. Because of the relatively long reactivation and on-stream periods, the time-cycle mechanism is used also to change conditions in fractionating towers to take care of variations in product quality with change in catalyst activity.

Although the hydroforming process is sufficiently flexible to produce gasoline over a wide range of octane numbers up to 90 A.S.T.M., conditions selected for the Texas City plant

produce 80 per cent. of an 80 A.S.T.M. octane number gasoline. The product contains 40 to 50 per cent. of aromatics. From 15 to 20 per cent. of these are toluene; most of the balance consists of xylenes and higher aromatics.

### Toluene Production

Either straight-run or cracked petrol may be re-formed and, in general, the product requires no treatment to render it suitable for the market. By changing operating conditions, the hydroforming process can produce a high-grade aviation spirit, or can be modified for a product having over 80 per cent. aromatics. This latter feature, particularly important from a military standpoint, affords a means for substantially augmenting toluene production. The total United States production of toluene was 20,000,000 gallons in 1939, but the toluene content of the product from the Texas City plant alone is equivalent to an annual production of 5,000,000 gallons, about 25 per cent. of the country's total production in 1939. The unit is being operated under patent licence from the Standard Catalytic Co.

## LETTERS TO THE EDITOR

### Phenol

SIR,—On behalf of the producers of phenol, I have been asked to advise you that the Coal Tar Controller (Ministry of Mines) has agreed with the phenol producers to a schedule of fixed prices for phenol.

Each phenol producer now requires a licence to dispose of his phenol and the conditions on the licence necessitate all the phenol being supplied in directions indicated by the Coal Tar Controller. Licences have been issued for May and June and thereafter will be issued quarterly.

The phenol suppliers are prepared to consider contracts for delivery in May and June and each quarterly period thereafter commencing July 1, October 1, January 1 and April 1, subject always to the issue of the necessary licence for disposal. Prices will be as follows:—

In non-returnable drums without overkegs:

Under 1 ton	...	...	...	10½d.
1 ton and under 2 tons	...	...	...	10½d.
2 tons	5	...	...	10d.
5 "	10	...	...	9¾d.
10 "	20	...	...	9¾d.
20 "	and over	...	...	9½d.

Yours faithfully,  
for Whinney, Smith and Whinney,  
F. W. BAILEY.

Leeds, 1.  
May 2, 1941.

### Cheap Oxygen

SIR,—For the time being I do not think that the question of cheap oxygen is of any considerable interest to this country (see THE CHEMICAL AGE, 44, 1139, p. 237). There are only a few processes for which cheap oxygen in large quantities is essential and on the other hand it would be extremely difficult, if not impossible, to construct Linde-Fraenckl plants in this country under present conditions.

The process has been described by Mr. H. C. Millett, B.Sc., Ph.D., in "The Lurgi Process for Complete Gasification of Coal with Oxygen under Pressure," published by the Institute of Fuel, October, 1936, and, more recently, by Mr. Ruheman in his book about Gas Liquefaction. In addition to that there are several other papers published in German and French, dealing with the economic side of the Linde-Fraenckl process.

I think that after the war the question, as well as many others, will have to be considered from the peace-time point of view, and then a discussion on the subject will be of more practical value than nowadays.—Yours faithfully,

Scunthorpe.  
P. BORCHARDT, Dipl. Ing.

May 1, 1941.

\* From a paper by D. J. Smith and L. W. Moore, Pan-American Refining Corp., New York, in *News Edition of the American Chemical Society*, 1941, 19, 7, 428.

## New Chemical Methods

### Meeting of the American Chemical Society

GENERAL papers were presented at the meeting of the Division of Industrial and Engineering Chemistry, American Chemical Society, at St. Louis, Missouri, on April 8, and by courtesy of the Society we are enabled to publish abstracts of a selection of these.

"Synthetic Resins as Exchange Absorbents" was the subject chosen by R. J. Myers, J. W. Eastes, H. C. Cheetham, and F. J. Myers of the Resinous Products and Chemical Co., Inc. The recent development of synthetic resins which exhibit ion-exchange properties has opened a new field of application, promising unique uses in the purification of water and other fluids, in the recovery of valuable substances, in the removal of undesirable impurities, and in many other problems. Whereas the selection of a synthetic resin for a particular application has been based upon physical properties (hardness, solubility, colour, etc.), the applications of synthetic resins as ion exchangers focuses attention upon the chemical properties of the resins. Thus, the phenol-aldehyde resins can be prepared to function as cation-exchangers and may be used in the sodium cycle for removal of hardness-producing ions, such as calcium, iron, etc., or in the hydrogen cycle to replace all cations with hydrogen. Again, amine-aldehyde resins may be prepared which function as acid-absorbents, or "anion-exchangers," and may be used to recover or remove acid radicals from solutions. The treatment of water by a cation-exchange resin, and then by an acid-absorbent resin, leads to the production of a high quality "distilled water" which compares favourably with and in some cases exceeds the quality of laboratory distilled water.

#### Advantages of Resin Exchangers

Resinous ion-exchangers offer the following advantages: high capacity, high exchange velocity, excellent stability—both mechanical and chemical—to acids, alkalies, and heat, uniformity of quality, low operating costs, and freedom from "leakage" of ions being removed. They may be used in the softening of water; and in the partial or complete removal of dissolved salts from water, sugar solutions, protein solutions, and biological and pharmaceutical media. They are of value in the recovery of traces of copper and other valuable metals from dilute solutions, and in the removal of iron and objectionable acids from waters and industrial products, such as enzyme extracts, dyestuffs, pigments, sugar solutions, and pharmaceutical preparations. Synthetic resins have been prepared with a wide range of physical and chemical properties and many of these have been examined and compared with the older exchange adsorbents. The results indicate a superior behaviour and a combination of properties not possessed by any material hitherto used for the applications thus far examined.

#### Phosphoric Acid Manufacture

J. H. Walthall and M. M. Striplin, Jr., of the Tennessee Valley Authority, in a paper entitled "Superphosphoric Acid by Absorption of Phosphorus Pentoxide Vapour" describe the pilot-plant development of a new process for manufacturing phosphoric acid. Phosphorus is burned with dried air and the resulting phosphorus pentoxide vapour is absorbed in concentrated aqueous solutions containing about 85 per cent. phosphorus pentoxide (superphosphoric acid). Concentrated solutions, of low water-vapour pressure, and dried air are employed to avoid the formation of an acid mist resulting from hydration of the phosphorus pentoxide in the vapour phase. The absorption step is carried out at temperatures above 260° C. in order to prevent condensation of phosphorus pentoxide to the solid phase. The resulting solution is a viscous liquid which can be diluted with water to yield either pyrophosphoric acid or orthophosphoric acid, according to the quantity of water used for dilution:

"Ferric Sulphate for Metal Pickling" is the subject dis-

cussed by J. O. Percival, C. P. Dyer, and M. H. Taylor of the Merrimac Division, Monsanto Chemical Co. Ferric sulphate is gradually replacing nitric acid and sodium dichromate as a pickling agent for stainless steel and copper alloys respectively. Satisfactory pickling baths contain both an acid to dissolve oxide scale and an oxidising agent to assist in descaling and produce a pleasing appearance of the exposed metal. The chemistry of the action of ferric sulphate baths in each application and the general method of use are discussed, and the practicability of ferric sulphate for this use is demonstrated by chemical data, photographs, and finally by a graph showing the steady increase through the years of its use for metal pickling.

#### Calcium Metaphosphate

In the manufacture of calcium metaphosphate, rock phosphate is treated with  $P_2O_5$  at elevated temperatures. To study the factors affecting this reaction, G. L. Frear and L. H. Hull, of the Tennessee Valley Authority, suspended pellets of rock phosphate of different compositions, of fluorapatite, and of lime in a tube furnace in a stream of gas containing  $P_2O_5$ . The temperature, gas velocity,  $P_2O_5$  concentration, and water-vapour concentration were varied and the gain in weight of the specimen measured. At the instant of initial exposure the rate of reaction of  $P_2O_5$  with the pellet was nearly independent of the temperature in the range 700° to 1100° C., varied with the gas velocity, and was directly proportional to the  $P_2O_5$  concentration, indicating that the transfer through the gas film was the rate-determining step. After a period of exposure which varied with the conditions, the rate of the reaction generally decreased, became more dependent upon the temperature and less dependent upon the gas velocity, and ceased to be proportional to the  $P_2O_5$  concentration, thus showing that the transfer through the coating of liquid product forming on the pellet was the rate-determining step. The rate of reaction of  $P_2O_5$  with the different materials decreased in the order: lime, fluorapatite, rock phosphate. The observed rates were not appreciably affected by the concentration of water vapour.

## Magnetic Settling

#### Rapid Method of Water Purification

A MAGNETIC method of purifying water which is claimed to increase the settling capacity of basins by 500 to 1000 per cent. and to speed purification is the subject of three patents issued to Oliver M. Urbain and William R. Stemen, of Columbia, Ohio. The settling of the organic impurities from the water is claimed to take from 75 to 90 per cent. less time by the new method. In addition the sediment or sludge formed is so condensed that it occupies only 35 per cent. of the volume of sludge obtained by earlier methods of water purification.

In the conventional methods, organic impurities are removed by adding absorbents and coagulants, such as ferric chloride and alum, to the impure water. The treated water is passed to settling basins or tanks where the impurities are permitted to settle out. This takes from three to four hours. In the new method, powdered magnetic materials, such as iron, cobalt, nickel, and their alloys, or the iron known as magnetite, are dispersed in the water. The treated water is then passed into the settling tanks which are fitted at the bottom with electro-magnets. The magnetic forces generated by the latter attract the magnetic particles, which drag the impurities with them as they are drawn rapidly to the bottom of the tank.

About 200 to 500 lb. of magnetic powder to each million gallons of water are all that is required to cause quick magnetic settling.



## General News

THE MINISTRY OF FOOD announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users for the four weeks ending May 31.

UNDER A BOARD OF TRADE ORDER (S.R. & O. 1941 No. 592) which comes into force on May 14, licences will be required to export, to all destinations, bones (including bone flour, bone grist, and bone meal), all preparations of scilla (squill), tizrah roots and leaded zinc.

A LECTURE ON "Red Lead and Red Lead Paint" was delivered to the Manchester Section of the Oil and Colour Chemists Association, on Friday, May 9, in the Reynolds Lecture Hall of the Manchester College of Technology. Mr. T. W. J. Chater, A.I.C., was the lecturer.

REMARKING THAT PRESENT-DAY Iron and Steel Control Orders were complicated and extremely difficult to construe, the Bow Street magistrate, Mr. Fry, dismissed four summonses against Aircraft Materials, Ltd., on payment of costs. It had been alleged that they had unlawfully acquired iron and steel. Speaking on behalf of the Director of Public Prosecutions, Mr. G. Howard said that there was no suggestion of any dishonest intention on the part of the company.

BEGINNING THIS WEEK, AN EXHIBITION illustrating various methods for the protection of glass in factories, of glass substitution, and of ventilation and obscurity in the black-out, may be seen simultaneously in London (The Building Centre, 158 New Bond Street), Glasgow (The Building Centre, 425 Sauchiehall Street), Manchester (Municipal School of Art), and Bristol (Museum and Art Gallery). Exhibits from more than 150 firms will be shown, all of which are in accordance with the requirements of the Ministry of Home Security.

THE BOARD OF TRADE HAS ISSUED the Trading with the Enemy (Specified Persons) (Amendment) (No. 6) Order, 1941, dated April 25. The Order came into operation on May 1. Trading with the Enemy (Specified Persons) (Amendment) (Nos. 2, 3, 4, and 5) Orders, 1941, are revoked. The new Order is to some extent a consolidating order, in that two earlier lists of names are revoked, as well as certain specified areas, but only because they are now redundant. The new list covers 75 pages, and contains about 2500 names, and the price is 1s. 6d.

FOR USING FARINA without a licence from the Ministry of Food, James Williamson and Sons, Ltd., linoleum manufacturers, Lancaster, were summoned at Lancaster last week. The prosecution produced a declaration stating that in May, 1940, the firm had 38 tons, 12 cwt. of farina in stock. In September it was found that about 24 tons had been used without a licence. Defendants pleaded that there had been a slight misreading of the Ministry's order. The case would never have come to light if they had not made an application to the Ministry for consent to buy more farina when their stocks were getting low. There was a fine of £4, and defendants were ordered to pay 2 guineas costs.

A WAR EMERGENCY BRITISH STANDARD for cast brass bars (suitable for forging) and forgings is about to be issued by the British Standards Institution at the request of the Ministry of Supply. The specification is intended to provide material which may for some purposes be used as an alternative to rolled or extruded brass bars as covered by B.S. 218, in order to relieve the pressure of the demand for such bars. The specification has accordingly been modelled on the lines of B.S. 218; it includes the same chemical composition, but with an appropriate modification to the mechanical testing requirements. Copies, 2s. 3d. each, will be obtainable at the British Standards Institution, 28 Victoria Street, London, S.W.1.

## Foreign News

TWO PROSPECTORS IN THE EMPLOY of the Newfoundland Government are reported to have discovered a chromite deposit recently on Fox Island, Newfoundland.

MONOCHLOROTHYMOL and monochloroisothymol have been found very effective in the preserving of casein, glues, and starches. (R. S. Law, *J.S.C.I.*, 1941, 60, 3, 66). There is little to choose between the two forms of chlorothymol except that the solid monochlorothymol, setting point 59–61°C, is a little more effective in preserving starch mucilages than the liquid monochloroisothymol.

## From Week to Week

A PRODUCT DEVELOPED from pulverised asphalt is being offered in U.S.A. for conversion into an inexpensive paint on mixture with turpentine or petroleum solvents.

A FACTORY FOR THE PRODUCTION of metallic magnesium is reported to be now in action at Bolzano, in Italian Tyrol. It is stated that the electric furnaces there will produce sufficient of the material to satisfy Italian needs.

FIVE NEW SULPHITE ALCOHOL plants are reported to be under construction in Sweden. The new plants will have an aggregate capacity of about 18 million litres of 95 per cent. alcohol. Several existing sulphite spirit plants will be enlarged.

MAGNESIUM CHLORIDE, COMMERCIAL GRADE, for all purposes, has now been classified by the Australian Commonwealth Department of Trade and Customs under Tariff Item No. 404, and is therefore duty-free under the British preferential tariff.

EXPERIMENTS CONDUCTED BY V. N. Ipatieff and Robert L. Burwell, Jr., have shown that "solid phosphoric acid" is an excellent catalyst for the production of dimethyl ether from methanol. It will catalyse the following reactions: between ethanol and methanol to form ethyl methyl ether; between diethyl and dimethyl ethers to form ethyl methyl ether; and between benzyl and methyl alcohols to form benzyl methyl ether (*J. Am. Chem. Soc.*, 1941, 63, 4, 969).

## Forthcoming Events

THE NINTH ANNUAL GENERAL MEETING of the Plastics Group, Society of Chemical Industry, will take place in the Rooms of the Chemical Society, Burlington House, Piccadilly, W.1, at 4.30 p.m., on May 12.

A JOINT MEETING of the Plastics Group, Society of Chemical Industry, with the Institution of the Rubber Industry, will be held at 5 p.m. on May 12, in the Rooms of the Chemical Society, Burlington House, Piccadilly, W.1. Two papers will be presented:—"The Part played by Plastics in the Electrical Industry," by Dr. G. Haefely (Messrs. Micanite and Insulators, Ltd.), and "Rubber Insulating Materials," by Mr. H. A. Daynes (Siemens, Ltd.).

THE ROYAL SOCIETY OF ARTS (Dominions and Colonies Section) is holding a meeting on May 13 at 2.30 p.m., at the Institution of Electrical Engineers, Victoria Embankment, W.C.2. A paper, illustrated by lantern slides, on "Research in Canada," will be read by Lieut.-General A. G. McNaughton, C.B., C.M.G., D.S.O., G.O.C. 1st Canadian Corps Overseas Force, and President of the National Research Council of Canada. The Rt. Hon. R. B. Bennett, K.C., will preside.

A JOINT MEETING of the Institution of Chemical Engineers and the Chemical Engineering Group (Society of Chemical Industry), will be held on May 13, at 2.30 p.m., in the rooms of the Geological Society, Burlington House, Piccadilly, London, W.1, when a paper on "Economical Raising of Steam in Small and Medium-size Boiler Plants" will be presented by Dr. G. W. Himus, Ph.D.

THE TENTH ANNUAL MEETING of the Food Group, Society of Chemical Industry, to be held at Burlington House, London, on May 14, at 2.15 p.m., will be followed by an address by Professor E. P. Cathcart, C.B.E., F.R.S., entitled "Changes in Wartime Diet and Effects on Individual Health."

THE NEXT MEETING of the Fuel Luncheon Club will take place at the Connaught Rooms, Great Queen Street, Kingsway, W.C.2, on May 14, at 12.40 for 1.10 p.m., when the after-luncheon address on "Some New Processes on the Farm" will be given by Dr. R. E. Slade, M.C., Research General Manager of Imperial Chemical Industries, Ltd.

THE EIGHTH LIVERSIDGE LECTURE of the Chemical Society, on "Complex Formation," will be delivered by Professor N. V. Sidgwick, C.B.E., F.R.S., at Burlington House, Piccadilly, W.1, on May 15 at 4.15 p.m. Professor Sidgwick will also deliver the lecture at Leeds on May 13 at 7.30 p.m. in the chemistry lecture theatre of the University.

ON FRIDAY, MAY 16, at 5 p.m., Dr. A. E. Dunstan will lecture before the Institute of Chemistry at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. His subject is "Recent Syntheses in the Petroleum Industry."

## Personal Notes

The medal of the Society of Chemical Industry for 1941 will be awarded to SIR ROBERT PICKARD, F.R.S., at the annual general meeting of the Society on July 8.

MR. THOMAS MOODIE, an assistant in the flour department laboratories, Leith, of the Scottish Co-operative Wholesale Society, has taken first place in organic and inorganic chemistry at the Heriot-Watt College, Edinburgh.

MR. J. SAYERS, Ph.D., who won a senior research award from the Department of Scientific and Industrial Research in 1938, has been made a fellow-elect at St. John's College, Cambridge.

SIR RICHARD GREGORY delivered an address on "Science in Civilisation" in the rooms of the Chemical Society, Burlington House, after the annual meeting of the London Section of the Society of Chemical Industry last Monday.

At the annual meeting of the Birmingham and Midland Section of the Society of Chemical Industry the following appointments were made:—Chairman, MR. GEORGE KING; vice-chairman, MR. GEORGE DRING; hon. treasurer, MR. W. T. COLLIS; hon. recorder, MR. J. E. SUCH; hon. auditor, DR. S. R. CARTER; hon. secretary, MR. H. S. POTTER.

MR. HENRY G. KNIGHT, chief of the Bureau of Agricultural Chemistry and Engineering, U.S. Department of Agriculture, has been awarded the medal of the American Institute of Chemistry in recognition of his outstanding accomplishments in the field of agricultural chemistry. The medal will be presented at the annual meeting of the Institute in Washington on May 17.

SIR PRAFULLA CHANDRA RAY, doyen of Indian chemists, celebrates his 80th birthday on August 7 this year. On the occasion of this anniversary, his friends, admirers, and pupils, have proposed raising a fund, associated with his name, for the furtherance of scientific and industrial research in India. Full details of the scheme are given in *Science and Culture* (March, 1941).

MR. E. B. ADAMS, MR. R. J. HANNAY, MR. S. HEAP, DR. H. A. THOMAS, and MR. G. M. WILLIAMS were elected members of the Manchester Sectional Committee of the Society of Dyers and Colourists for 1941/42 at the recent annual meeting. The Knecht Memorial Prize was awarded this year to MR. H. JOHNSON, a student of the Royal Technical College, Salford, and to MR. A. K. TAYLOR, a student of the Manchester College of Technology.

DR. ARTHUR W. BURWELL, technical director of the Alox Corporation, is to be awarded the Schœllkopf Medal of the Western New York Section of the American Chemical Society at the Niagara Falls meeting on May 20. The award is a recognition of his work in producing and utilising fatty acids, lactones, and other chemicals from petroleum, notably by oxidation of petroleum by air under the influence of heat, pressure, and catalysts.

The committee of the Plastics Group of the Society of Chemical Industry has appointed the following officers for the session 1941-1942: Chairman, DR. G. S. WHITBY; vice-chairman, MR. E. G. COUZENS; hon. recorder, DR. H. S. BELL; hon. treasurer, MR. A. J. GIBSON; hon. secretary, MR. N. J. L. MEGSON. MR. AUSTIN LOWE, chairman for the last year, fills, *ex officio*, one of the four vacancies on the committee. MR. C. CHAPMAN and MR. L. M. READ fill two more of the positions and the fourth vacancy will be filled by election.

## OBITUARY

MR. ALEXANDER W. TAWSE, who recently died at his home in Aberdeen, was manager of Isaac Spencer and Co., Ltd., paint and fish-oil manufacturers, Aberdeen.

MR. W. W. MYERS, who died on May 1 in his 60th year, was office manager of the Carborundum Co., Ltd., Trafford Park, Manchester.

PROFESSOR E. F. FRANCIS, who died recently at Bristol in his 69th year, was Emeritus Professor of Chemistry at Bristol University. He graduated at Liverpool and Erlangen and became Assistant Professor at Bristol in 1903. Three years later he succeeded Prof. M. W. Travers in the Alfred Capper Pass chair, which he occupied until his retirement in 1936. He was also Dean of the Faculty of Science and Pro-Vice Chancellor. When war broke out, despite a previous serious illness, he returned to the University to collaborate in special work.

## Chemical Matters in Parliament

### Paraffin Wax and Scale

IN the House of Commons last week, Mr. Wootton-Davies asked the Secretary for Petroleum the amounts of paraffin wax and paraffin scale imported from America and Burma during the last six months.

Mr. Lloyd, having stated that he could not reply to the question in the national interest, was then asked by Mr. Wootton-Davies regarding the c.i.f. costs of Burma waxes and American paraffin scale and wax, and the respective prices charged to users over the last six months.

Replying, Mr. Lloyd said that during the period October 1, 1940, to March 31, 1941, the approved selling prices *ex store* of paraffin scale had varied from £23 3s. 4d. to £28 11s. 3d. and of refined paraffin wax (50° C.) from £42 12s. 9d. to £45 12s. 6d. The second figures mentioned in each case were the current prices.

## Structurally Modified Rubber

### Cyclisation in Presence of Halides

MODIFICATION of rubber by chemical addition, for example, by chlorine or oxygen, is finding increasing application in industry largely on account of the reduced unsaturation of the hydrocarbon resulting in less change in physical properties under the attack of atmospheric oxygen or chemical reagents and also to specific effects, *e.g.*, that of combined chlorine in fire resistance, etc.

Rubber may, however, be modified by an intramolecular change involving a type of cyclisation which reduces the unsaturation without introducing an appreciable amount of foreign elements. Such cyclisation was effected pyrogenetically as early as 1838, and has since been carried out by many chemists by very various means (H. R. Thies, Goodyear Tire and Rubber Co., U.S.A., *Ind. Eng. Chem.*, 1941, 33, 389). The operation is conveniently carried out in solution in the presence of halides of, *e.g.*, hydrogen, tin, aluminium, boron, and phosphorus, and the products made by the above company are given the generic trade name of "Pliolite." They are in general fine white powders with which rubber may be compounded, acting as a plasticiser of the Pliolite; and by this means wide variation in physical and chemical properties and in applications is possible. For electrical insulation the incorporation of 10 per cent. Pliolite with a suitably compounded rubber enables thin insulating coatings to be extruded on wire at a high speed and with very satisfactory results.

### PLASTICISERS FOR SHELLAC

A study of the effect of 30 plasticisers on the properties of the films of dewaxed lac and fibrous and hard lac resin made from the dewaxed lac has been made by G. D. Heath and B. S. Gidvani and published by the London Shellac Research Bureau (Technical Paper No. 20). Prevention of crazing, resistance to water and solvents, and other properties were investigated and the conclusion was reached that the following are good general plasticisers for all shellacs: sextol phthalate, cyclohexanol tartrate, *p*-toluene sulphonamide, and Santiciser IH.

# Weekly Prices of British Chemical Products

**CONDITIONS** in the market for general chemicals have pursued pretty much the same course as the previous week, and a moderate weight of new business is in evidence. A steady flow of deliveries against contracts is reported, and the movement here is fairly substantial. In regard to the price position there is no change of any importance to record, although the tendency throughout remains firm. A strong demand continues for most of the potash and soda products and a number of items available only for approved requirements. Acetic, tartaric and citric acids are on active demand. Bright conditions continue to be displayed in the market for coal tar products, and values, with few exceptions, remain on firm basis. There is a good demand for cresylic acid, carbolic acid and creosote oil, whilst xylol and both solvent and heavy naphtha are strong. A slight improvement is reported in the position of pyridine.

**MANCHESTER.**—New inquiry on the Manchester chemical market during the past week has resulted in moderate additions to sellers' order-books, both for home consumption and export. With regard to contract deliveries, these are said to be going forward fairly

satisfactorily. Chemical values as a whole are on a firm basis, though actual changes on balance are few. The demand for most of the tar products, including crude tar, creosote oil, cresylic acid, the light distillates, and the naphthalenes, has been on steady lines and prices are strong.

**GLASGOW.**—There has been no appreciable change in the Scottish heavy chemical trade during the past week either for home or export business. Business has kept extremely steady for some time now. Prices remain firm.

## Price Changes

**Rises:** Barytes, Carbolic Acid, Carbon Black, Cream of Tartar, Cresylic Acid, Hydrochloric Acid, India Rubber Substitutes, Methyl Acetone, Naphtha, Nitric Acid, Sodium Carbonate Monohydrate, Sodium Sulphate (Salt Cake), Tartaric Acid, Vegetable Lamp Block, Xylol.

**Falls:** Antimony Sulphide, Naphthalene, Pyridine, Sodium Silicate, Vermilion, Wood Tar.

## General Chemicals

**Acetic Acid.**—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./1 ton, £40 10s.; 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 10s. per ton extra if packed and delivered in glass.

**Acetone.**—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

**Alum.**—Loose lump, £9 10s. per ton, d/d, nominal.

**Aluminium Sulphate.**—£8 to £8 10s. per ton d/d.

**Ammonia Anhydrous.**—1s. 7d. to 2s. 2d. per lb.

**Ammonium Carbonate.**—£39 to £40 per ton d/d in 5 cwt. casks.

**Ammonium Chloride.**—Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. **MANCHESTER:** Grey galvanising, £22 10s. per ton. See also Sal ammoniac.

**Antimony Oxide.**—£68 per ton.

**Arsenic.**—99/100%, about £31 10s. per ton, ex store.

**Barium Chloride.**—98/100%, prime white crystals, £11 10s. to £13 per ton, bag packing, ex works; imported material would be dearer.

**Bleaching Powder.**—Spot, 35/37%, £10 7s. 6d. per ton in casks, special terms for contract.

**Borax, Commercial.**—Granulated, £26; crystals, £27; powdered, £27 10s.; extra fine powder, £28 10s.; B.P. crystals, £35; powdered, £35 10s.; extra fine, £36 10s. per ton for ton lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £73; powder, £74 per ton in tin-lined cases for home trade only, packages free, carriage paid.

**Boric Acid.**—Commercial, granulated, £42 10s.; crystals, £43 10s.; powdered, £44 10s.; extra fine powder, £46 10s.; large flakes, £55; B.P. crystals, £51 10s.; powdered, £52 10s.; extra fine powdered, £54 10s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

**Calcium Bisulphite.**—£6 10s. to £7 10s. per ton f.o.r. London.

**Calcium Chloride.**—70/72% solid, £5 15s. per ton ex store.

**Charcoal Lump.**—£10 10s. to £14 per ton, ex wharf. Granulated, supplies scarce.

**Chlorine, Liquid.**—£21 7s. 6d. per ton, d/d in 16/17 cwt. drums (3-drum lots); 5½d. per lb. d/d station in single 70-lb. cylinders.

**Chrometan.**—Crystals, 5½d. per lb.; liquor, £23 per ton d/d station in drums.

**Chromic Acid.**—1s. 2d. per lb., less 2½%; d/d U.K. **GLASGOW:** 1s. 0½d. per lb. for 1 cwt. lots.

**Citric Acid.**—1s. 2d. per lb. **MANCHESTER:** 1s. 6d.

**Copper Sulphate.**—About £29 10s. per ton f.o.b. **MANCHESTER:** £29, less 2%, in 5 cwt. casks f.o.b. Liverpool.

**Cream of Tartar.**—100%, 252s. per cwt., less 2½%, d/d in sellers' returnable casks.

**Formaldehyde.**—£21 15s. to £25 per ton d/d. **MANCHESTER:** 40%, £22 to £25 per ton in casks d/d; imported material dearer.

**Formic Acid.**—85%, £47 per ton for ton lots, carriage paid, carbonyl returnable; smaller parcels quoted up to 50s. per cwt., ex store.

**Glycerine.**—Chemically pure, double distilled 1260 s.g., in tins, £3 15s. to £4 15s. per cwt., according to quantity; in drums, £3 7s. 6d. to £4 1s. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

**Hexamine.**—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

**Hydrochloric Acid.**—Spot, 6s. 3½d. to 8s. 9½d. carboy d/d, according to purity, strength and locality.

**Iodine.**—Resublimed B.P., 9s. 11d. to 13s. 11d. per lb., according to quantity.

**Lactic Acid.**—Dark tech., 50% by vol., £31 per ton; 50% by weight, £38; 80% by weight, £67; pale tech., 50% by vol., £39 10s.; 50% by weight, £46; 80% by weight, £74. Not less than one ton lots ex works; barrels returnable, carriage paid.

**Lead Acetate.**—White, £46 10s. to £48 10s. ton lots. **MANCHESTER:** £46 to £48 per ton.

**Lead Nitrate.**—About £45 10s. per ton d/d in casks.

**Lead, Red.**—English, 5/10 cwt. £42; 10 cwt. to 1 ton, £41 15s.; 1/2 tons, £41 10s.; 2/5 tons, £41; 5/20 tons, £40 10s.; 20/100 tons, £40; over 100 tons, £39 10s. per ton, less 2½ per cent. carriage paid; non-setting red lead 10s. per ton dearer in each case. Continental material £1 per ton cheaper.

**Lead, White.**—Dry English, less than 5 tons, £53 10s.; 5/15 tons, £49 10s.; 15/25 tons, £49; 25/50 tons, £48 10s.; 50/200 tons, £48 per ton less 5 per cent. carriage paid; Continental material £1 per ton cheaper. Ground in oil, English, 1/5 cwt., £62; 5/10 cwt., £61; 10 cwt. to 1 ton, £60 10s.; 1/2 tons, £59; 2/5 tons, £58; 5/10 tons, £56; 10/15 tons, £55; 15/25 tons, £54 10s.; 25/50 tons, £54; 50/100 tons, £53 10s. per ton less 5 per cent., carriage paid. Continental material £2 per ton cheaper.

**Litharge.**—1 to 2 tons, £41 10s. per ton.

**Lithium Carbonate.**—7s. 9d. per lb. net.

**Magnetite.**—Calcined, in bags, ex works, £14 to £17 per ton

**Magnesium Chloride.**—Solid (ex wharf), £12 to £13 per ton. **MANCHESTER:** £13 to £14 per ton.

**Magnesium Sulphate.**—Commercial, £10 to £12 per ton, according to quality, ex works.

**Mercury Products.**—Controlled price for 1 cwt. quantities: Bichloride powder, 11s. 7d.; bichloride lump, 12s. 2d.; ammon. chloride powder, 13s. 5d.; ammon. chloride lump, 14s.; mercurous chloride, 13s. 9d.; mercury oxide, red cryst., B.P., 15s.; red levig. B.P., 15s. 6d.; yellow levig. B.P., 14s. 9d.; yellow red, 14s. 4d.; sulphide, red, 12s. 11d.

**Methylated Spirit.**—Industrial 66° O.P. 100 gals., 2s. 0½d. per gal.; pyridinised 64° O.P. 100 gals., 2s. 5d. per gal.

**Nitric Acid.**—£23 to £31 per ton ex works.

**Oxalic Acid.**—From £60 per ton for ton lots, carriage paid, in 5-cwt. casks; smaller parcels would be dearer; deliveries slow.

**Paraffin Wax.**—Nominal.

**Potash, Caustic.**—Basic price for 50-100 ton lots. Solid, 88/92%, commercial-grade, £53 15s. per ton, c.i.f. U.K. port. duty paid. Broken, £5 extra; flake, £7 10s. extra; powder, £10 extra per ton. Ex store, £3 10s. supplement.

**Potassium Bichromate.**—Crystals and granular 7d. per lb.; ground 7d. per lb., carriage paid. **MANCHESTER** and **GLASGOW:** 7d. per lb. in orig. casks.

**Potassium Carbonate.**—Basic prices for 50 to 100 ton lots: hydrated, 83/85%, £46 17s. 6d. per ton; calcined, 98/100%, £52 10s. per ton, c.i.f. U.K. port. Ex warehouse, £3 10s. extra per ton.

**Potassium Chlorate.**—Imported powder and crystals, ex store London, 10d. to 1s. per lb.

**Potassium Iodide.**—B.P., 8s. 8d. to 12s. per lb., according to quantity.



**Potassium Nitrate.**—Small granular crystals, £26 to £30 per ton ex store, according to quantity.

**Potassium Permanganate.**—B.P., 1s. 5½d. per lb. for 1 cwt. lots; commercial, £7 9s. 6d. to £8 1s. 6d. per cwt., according to quantity d/d.

**Potassium Prussiate.**—Yellow, about 1s. 3d. to 1s. 5d. per lb., supplies scarce.

**Salammoniac.**—First lump, spot, £18 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

**Soda, Caustic.**—Solid, 76/77% spot, £14 17s. 6d. per ton d/d station.

**Soda Crystals.**—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

**Sodium Acetate.**—£37 to £40 per ton, ex wharf.

**Sodium Bicarbonate (refined).**—Spot, £11 per ton, in bags.

**Sodium Bichromate.**—Crystals, cake and powder, 5½d. per lb., anhydrous, 6d. per lb. net d/d U.K. MANCHESTER and GLASGOW: 5½d. per lb., in orig. casks.

**Sodium Bisulphite Powder.**—60/62%, £17 10s. per ton d/d in 2-ton lots for home trade.

**Sodium Carbonate Monohydrate.**—£21 per ton d/d in minimum ton lots in 2 cwt. free bags.

**Sodium Chlorate.**—£36 to £45 per ton, d/d, according to quantity.

**Sodium Hyposulphite.**—Pea crystals, £19 15s. per ton for 2-ton lots; commercial, £14 10s. per ton. MANCHESTER: Commercial, £14 10s.; photographic, £19 15s.

**Sodium Iodide.**—B.P., for not less than 28 lb., 9s. 6d. per lb.; for not less than 7 lb., 13s. 1d. per lb.

**Sodium Metasilicate.**—£14 5s. per ton, d/d U.K. in cwt. bags.

**Sodium Nitrate.**—Refined, £18 10s. per ton for 2-ton lots d/d

**Sodium Nitrite.**—£22 to £23 per ton for ton lots.

**Sodium Perborate.**—10%, £5 2s. per cwt.

**Sodium Phosphate.**—Di-sodium, £19 to £22 per ton d/d for ton lots. Tri-sodium, £25 to £27 per ton d/d for ton lots.

**Sodium Prussiate.**—From 7½d. per lb. ex store.

**Sodium Silicate.**—£8 17s. 6d. to £9 10s. per ton, for 4-ton lots.

**Sodium Sulphate (Glauber Salts).**—£4 10s. per ton d/d.

**Sodium Sulphate (Salt Cake).**—Ungrained. Spot £4 13s. 6d. per ton d/d station in bulk. MANCHESTER: £4 13s. 6d. per ton d/d station.

**Sodium Sulphide.**—Solid 60/62%, Spot, £17 5s. per ton d/d in drums; crystals, 30/32%, £12 12s. per ton d/d in casks.

**Sodium Sulphite.**—Anhydrous, £29 10s. per ton; Pea crystals, spot, £18 10s. per ton d/d station in kegs; commercial, £12 15s. per ton d/d station in bags.

**Sulphur.**—Finely powdered, £18 10s. per ton d/d; precip. B.P., 68s. per cwt.

**Sulphuric Acid.**—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic-free, £4 11s. per ton; 140° Tw. arsenious, £4 3s. 6d. per ton; quotations naked at sellers' works.

**Tartaric Acid.**—3s. 0½d. per lb., less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 3s. 0½d. per lb.

**Zinc Oxide.**—Maximum prices: White seal, £30 17s. 6d. per ton; red seal, £28 7s. 6d. d/d; green seal, £29 17s. 6d. d/d buyers' premises.

**Zinc Sulphate.**—Tech., about £25, carriage paid, casks free.

### Rubber Chemicals

**Antimony Sulphide.**—Golden, 10d. to 1s. 2d. per lb. Crimson, 1s. 8½d. to 2s. per lb.

**Arsenic Sulphide.**—Yellow, 1s. 9d. per lb.

**Barytes.**—Best white bleached, £8 3s. 6d. per ton.

**Cadmium Sulphide.**—5s. 6d. to 6s. 6d. per lb.

**Carbon Black.**—5½d. to 8½d. per lb., according to packing.

**Carbon Bisulphide.**—£33 5s. to £38 5s. per ton, according to quantity, in free returnable drums.

**Carbon Tetrachloride.**—£46 to £49 per ton.

**Chromium Oxide.**—Green, 1s. 6d. per lb.

**India-rubber Substitutes.**—White, 6d. to 8½d. per lb.; dark, 5½d. to 8½d. per lb.

**Lithopone.**—30%, £25 per ton; 60%, £31 to £32 per ton. Imported material would be dearer.

**Mineral Black.**—£10 to £14 per ton.

**Mineral Rubber, "Rupron."**—£20 per ton.

**Sulphur Chloride.**—7d. per lb.

**Vegetable Lamp Black.**—£45 per ton.

**Vermillion.**—Pale or deep, 13s. 8d. per lb., for 7 lb. lots and less. Plus 5% War Charge.

### Nitrogen Fertilisers

**Ammonium Phosphate Fertilisers.**—Type A, £21 8s.; B, £15 5s. 6d.; C, £18 17s. per ton in 6-ton lots, d/d farmer's nearest station up to June 30, 1941.

**Ammonium Sulphate.**—Per ton in 6-ton lots, d/d farmer's nearest station: March/June, £10 2s.

**Calcium Cyanamide.**—Nominal: supplies very scanty.

**Concentrated Complete Fertilisers.**—£15 10s. to £16 3s. 6d. per ton in 6-ton lots, d/d farmer's nearest station up to June 30, 1941. Supplies small except C.C.F. Special at £15 14s. per ton.

**"Nitro-Chalk."**—£9 14s. per ton in 6-ton lots, d/d farmer's nearest station up to June 30, 1941.

**Sodium Nitrate.**—Chilean, £13 10s. per ton in 2-ton lots, f.o.r. Liverpool, March delivery; agricultural, £10 14s. per ton in 2-cwt. bags, d/d farmer's nearest station up to June 30, 1941.

### Coal Tar Products

**Benzol.**—Industrial (containing less than 2% of toluol), 2s. to 2s. 2d. per gal., ex works.

**Carbolic Acid.**—Crystals, 9½d. to 10½d. per lb.; Crude, 60's 3s. 3d. to 4s. 3d., according to specification. MANCHESTER: Crystals, 10½d. per lb., d/d; crude, 3s. 7d. to 3s. 10d. naked at works.

**Cresosote.**—Home trade, 5d. to 5½d. per gal., f.o.r., maker's works; exports 6d. to 6½d. per gal., according to grade. MANCHESTER: 5½d. to 7½d. per gal.

**Cresylic Acid.**—Pale 99/100%, 2s. 6d. to 2s. 8d. per gal. MANCHESTER: Pale, 99/100%, 2s. 9d. per gal.

**Naphtha.**—Solvent, 90/160°, 2s. 4d. to 2s. 7d. per gal.; Heavy 90/190°, 1s. 8d. to 1s. 9d., naked at works. MANCHESTER 90/160°, 2s. 4d. to 2s. 7d.

**Naphthalene.**—Crude, whizzed or hot pressed, £14 per ton; purified crystals, £27 per ton in 2-cwt. bags; flaked, £27 per ton. Fire-lighter quality, £6 to £7 per ton ex works. MANCHESTER: Refined, £27 per ton.

**Pitch.**—Medium, soft, nominal, f.o.b. MANCHESTER: Nominal.

**Pyridine.**—90/140°, 17s. per gal.; 90/160°, 13s. 6d.; 90/180°, 4s. to 5s. per gal., f.o.b. MANCHESTER: 13s. to 17s. per gal.

**Toluol.**—Pure, 2s. 5d., nominal. MANCHESTER: Pure, 2s. 5d. per gal., naked.

**Xylol.**—Commercial 3s. 6d. per gal.; pure, 3s. 8d. MANCHESTER: 3s. 4d. to 3s. 9d. per gal.

### Wood Distillation Products

**Calcium Acetate.**—Brown, £21 per ton; grey, £24. MANCHESTER: Grey, £23.

**Methyl Acetone.**—40 50%, £54 per ton.

**Wood Cresosote.**—Unrefined, 2s. per gal., according to boiling range.

**Wood Naphtha, Miscible.**—4s. 6d. to 5s. per gal.; solvent, 5s. per gal.

**Wood Tar.**—£4 to £5 per ton, according to quality.

### Intermediates and Dyes (Prices Nominal)

**m-Cresol 98/100%.**—Nominal.

**o-Cresol 30/31° C.**—Nominal.

**p-Cresol 34/35° C.**—Nominal.

**Dichloraniline.**—2s. 8½d. per lb.

**Dinitrobenzene.**—8½d. per lb.

**Dinitrotoluene.**—48/50° C., 9½d. per lb.; 66/68° C., 1s.

**p-Nitraniline.**—2s. 5d. per lb.

**Nitrobenzene.**—Spot, 5½d. per lb., in 90-gal. drums, drums extra. 1-ton lots d/d buyer's works.

**Nitronaphthalene.**—1s. 2d. per lb.; P.G., 1s. 0½d. per lb.

**o-Toluidine.**—1s. per lb., in 8/10 cwt. drums, drums extra.

**p-Toluidine.**—2s. 2d. per lb., in casks.

**m-Xylidine Acetate.**—4s. 5d. per lb., 100%.

### Latest Oil Prices

LONDON.—May 8.—For the period ending May 31, per ton, net, naked, ex mill, works or refinery, and subject to additional charges according to package and location of supplies:—

**LINSEED OIL, raw,** £41 10s. **RAPESEED OIL, crude,** £44 5s. **COTTONSEED OIL, crude,** £31 2s. 6d.; washed, £34 5s.; refined edible, £35 12s. 6d.; refined deodorised, £36 10s. **SOYA BEAN OIL, crude,** £33; refined deodorised, £37. **COCONUT OIL, crude,** £28 2s. 6d.; refined deodorised, £31 7s. 6d. **PALM KERNEL OIL, crude,** £27 10s.; refined deodorised, £30 15s. **PALM OIL, refined deodorised,** £37; refined hardened deodorised £41. **GROUNDNUT OIL, crude,** £35 10s.; refined deodorised, £40. **WHALE OIL, crude hardened,** 42 deg., £30 10s.; refined hardened, 42 deg., £33. **ACID OILS.**—Groundnut, £19; soya, £17; coconut and palm kernel, £22 10s. **ROBIN,** 25s. to 30s. per cwt., ex wharf, according to grade. **TURPENTINE,** 68s. 6d. per cwt. spot, American, including tax, ex wharf, in barrels, and ex discount.

LIVERPOOL.—May 7.—**TURPENTINE,** spot, American, 68s. 6d. per cwt.



# A 4 POINT PLAN TO INCREASE WAR PRODUCTION

## A MESSAGE TO MANAGEMENT.

In a recent broadcast speech, Mr. Ernest Bevin, Minister of Labour and National Service, showed how urgent was the need for more workers—especially women—in Great Britain's War Industries. Employers who are playing *their part* in the drive for greater and still greater war production will find this 4-point plan a sure guide.

### HERE ARE THE FOUR VITAL POINTS LAID DOWN BY THE MINISTRY OF LABOUR.

- 1 Skilled men are needed for the really skilled jobs. Be sure that each of your men is employed up to the very limit of his skill. Combat skilled labour shortage by breaking down processes wherever you can, and by training up your workpeople, men and women, to jobs of greater skill.
- 2 Training Schemes must be developed to the greatest possible extent. Take in more new workers for training on the job in your own works. Remember that the Government will help you with semi-skilled men and women trained under official schemes.
- 3 Prepare, now, to employ more and more women. Look constantly to women for your new recruits: they are excellently suited to many types of semi-skilled work. Hundreds of thousands must enter war production this year and every factory must play its part.
- 4 Efficient personnel management is essential. Remember that you must secure the whole-hearted co-operation of your workpeople. Look closely to their welfare. Many of them may be new to industry: be patient and help them all you can during the first difficult weeks. A little foresight will reduce your labour turnover.

THE MINISTRY OF LABOUR AND NATIONAL SERVICE HAS DISTRIBUTED A GUIDE TO THE EMPLOYMENT AND WELFARE OF WOMEN WORKERS. EVERY RESPONSIBLE EXECUTIVE—WHETHER HE BE EMPLOYER OR MANAGER—MUST INSIST ON SEEING IT.

You should make a special point of reading the new booklet "THE EMPLOYMENT OF WOMEN. SUGGESTIONS TO EMPLOYERS." Problems created by the increasing influx of new women workers into war factories are dealt with clearly . . . concisely; and the suggestions contained in the booklet will be of interest and great value to YOU! If you have not yet received your copy, instruct your secretary to write for one TO-DAY, to the local Employment Exchange, asking for pamphlet P.L. 87/1941.

#### These are the contents in the Booklet:

- |   |                                     |
|---|-------------------------------------|
| 1 Appointment of a Woman Personnel Officer.               | 4 Interviewing of candidates        |
| 2 Functions of a Woman Personnel Officer.                 | 5 On engagement.                    |
| 3 Consultations preparatory to the introduction of Women. | 6 On reporting for duty.            |
|   | 7 During first month of employment. |
|   | 8 Working hours.                    |

## MOBILISE FOR



ISSUED BY THE MINISTRY OF LABOUR & NATIONAL SERVICE

## Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

### Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an \*—followed by the date of the Summary, but such total may have been reduced.)

**DIESEL OIL VAPORISERS, LTD.** (London, S.W.—(M.L. 10/5/41). April 11, debenture to Westminster Bank, Ltd., securing all moneys due or to become due to the Bank; general charge. C.W.U.V.

### Companies Winding-Up Voluntarily

**COLLOID RUBBER CO., LTD.**—(C.W.U.V., 10/5/41). That the company be wound up voluntarily. G. R. Blouet, 7 Little Turnstile, Lincoln's Inn Fields, W.C., appointed liquidator.

**COLORFUSE, LTD.**—(C.W.U.V., 10/5/41). That the company be wound up voluntarily. Thomas Lister, 1 Oxford Court, Cannon Street, London, E.C.4., appointed liquidator.

**BELEVIERE CHEMICAL CO., LTD.**—(C.W.U.V., 10/5/41). By special resolution, April 25, that the company be wound up voluntarily. T. A. Clayton and G. S. Walkley, 16 New Street, Leicester, appointed joint liquidators.

## Company News

**Bofors A/B** have declared a dividend of 12 per cent. (same).

**Catalin, Ltd.**, announce a net profit of £3609 for 1940 (last year, net loss £11,264), reducing to £40,317 the debit carried forward.

**United Flexible Metallic Tubing Co., Ltd.**, have announced a final dividend of 5 per cent., plus a bonus of 6½ per cent., making 15 per cent. (same).

**Cellon, Ltd.**, report a net trading profit of £34,281, against £42,524 for 1939. The ordinary dividend is maintained at 20 per cent., with a final distribution of 10 per cent. To reserve, £7500 (against £12,500).

**The Kolok Manufacturing Co., Ltd.**, have declared dividends as follows: interim of 40 per cent. on deferred shares; additional of 5 per cent. on preferred ordinary shares; preferential of 12½ per cent. on preferred ordinary shares (same).

**Colvilles, Ltd.**, report that trading profit for the past year rose from £1,058,462 to £1,132,270, while dividends from subsidiaries fell from £147,522 to £96,416. The final ordinary dividend is 5 per cent., making 8 per cent. for 1940 (same), with a carry forward of £119,858.

**The United Molasses Co., Ltd.**, have declared a final ordinary dividend of 12½ per cent., making 20 per cent. for the year (22½ per cent.). In addition to this dividend there is a cash distribution (not subject to income tax) of 2½ per cent. (10 per cent.) payable out of capital reserve.

**The National Drug and Chemical Co. of Canada** report a net operating profit for 1940 of £25,008 (£19,585). With the addition of £33,176 (£32,913) from investments, etc., and the deduction of £24,391 (£14,686) for depreciation, taxes, etc., this leaves a net profit of £33,794 (£37,812). Forward £126,573 (£113,252). Interim preference dividend to January 31, 3 per cent. (same).

## New Companies Registered

**Associated Chemicals, Ltd.** (366,439).—Private company. Capital £1000 in 1000 shares of £1 each. Manufacturers of and dealers in chemicals, drugs, medicines, gypsum, plasters, disinfectants, fertilisers, oils, colours, glues, varnishes, dyes, polishes, etc. Subscribers: Stephen Docwra, C.A.; Persis Helin. Stephen Docwra is the first director. Registered office: 34 Norfolk Street, W.C.2.

**M. E. Spedding, Ltd.** (366,769).—Private company. Capital: £1000 in 900 preference shares of £1 and 2000 ordinary shares of 1s. each. Oil extractors, degreasers, distillers, producers and importers of and dealers in oils, lubricants, grease, tallow, paraffin, motor spirit, tar, bitumen and fuels, manufacturing chemists, oilcake and fertiliser manufacturers, etc. Subscribers: Chas. E. Hart and Geo. W. Clough. Secretary: Chas. E. Hart. Registered office: Albion Oil Works, Bradford Road, Batley.

## Chemical and Allied Stocks and Shares

DESPITE very inactive conditions, a steady undertone has been maintained in most sections of the Stock Exchange. Sentiment was again assisted by the absence of heavy selling pressure, but

apart from the continued firmness of British funds, few individual features developed. Shares of companies engaged in industries essential to the war effort were better in some instances, but in other directions prices did not appear to be tested adequately by business, the disposition being to await further developments in connection with the mobilisation of resources for essential war work.

Imperial Chemical were in request and have moved up to 30s. 3d. at the time of writing, while the preference units remained firm at the higher level of 34s. 6d. It is, of course, expected that the full report and accounts for 1940 will show that a strong financial position has been maintained, and moreover, the view appears to be gaining ground that there seems a reasonable possibility of the dividend being kept around 8 per cent. during the period of the war, bearing in mind that the I.C.I. has a satisfactory standard in regard to E.P.T. The units of the Distillers Co. had a firmer appearance at around 63s. on hopes that the dividend total for the financial year ending this month may again be brought up to 16½ per cent.; there is, of course, no doubt that the industrial alcohol and other sections of the business are playing an important part in the war effort. United Molasses eased, following publication of the preliminary results for the past year's working, but later became firmer, it being pointed out that the earnings shown must be regarded as a very good achievement, bearing in mind the conditions ruling. On the other hand, Lever & Unilever were reactionary, having moved back further to 20s. 3d., on fears of a reduction in the forthcoming dividend; the company's various classes of preference shares also made slightly lower prices compared with a week ago. In other directions, Borax Consolidated deferred units were virtually unchanged at 28s. 4½d. and, awaiting the dividend announcement, Barry & Staines improved to 27s., while elsewhere, Nairn & Green, which were 52s. 6d. British Aluminium had a steady appearance at 39s. 6d., at which the yield is approximately 5 per cent. on the basis of last year's 10 per cent. dividend, and the latter was on the conservative side, bearing in mind that 16½ per cent. was earned on the shares. United Glass Bottle have remained firm at 52s. 6d., at which the yield is only 4½ per cent.; in this case over 21 per cent. was earned on the shares and the actual payment was limited to 12 per cent. British Match have been very firm at 30s. xd. on the higher dividend, which came as a surprise to the market.

In other directions, Murex were steady at 81s., and Tube Investments were firmer at 90s., awaiting declaration of the interim dividend. The 5s. ordinary units of the Pressed Steel Co. have been very steady on the financial results, and elsewhere, United Steel made the slightly better price of 22s.; only small movements were shown in other leading iron and steel shares. Among other shares, British Plaster Board were higher at 13s. 9d., and a steady tendency was shown by Associated Cement. B. Laporte continued around 60s., and Fison Packard were 32s. 6d., while Greeff-Chemical Holdings 5s. units were again quoted at 5s. 7½d., and Monsanto Chemicals 5½ per cent. preference were 22s. 6d. Boots Drug had a steady appearance at 35s. 6d., aided by hopes that the forthcoming results may show the maintenance of the total distribution at the same rate as for the previous year. Timothy Whites shares remained firm on the dividend, and Sangers were virtually the same as a week ago. Owing to war developments in the Middle East, Burmah Oil, Anglo-Iranian, and other oil shares have been marked down in price, but no heavy selling was reported.

CANADIAN PRODUCTS EXPORTED to the United States had a total value of \$443 million in 1940, \$63 million more than in 1939, states the monthly newsletter of the Royal Bank of Canada. Of this increase \$49 million is accounted for by gains in shipments of wood and paper products, while the second largest gain for any group, \$17.9 million was in non-ferrous metals. As these are largely war materials, detailed statistics are not available. However, the nickel-copper industry reported the most active year in its history, with more nickel sold than in any previous year, and it may be assumed that nickel accounted for a large part of this increase. It must also be remembered that Canadian surplus supplies of copper, lead, and zinc were contracted for by British interests and hence were not available for export to the United States. Fertilisers made the important gain of \$680,000..

THE JOURNAL OF CHEMICAL EDUCATION records the appearance in America of certain "chemical games," which are doubtless designed to provide jam for the powder of elementary chemical research. These include: "Chemname," a game of matching cards bearing the common and chemical names of substances; "Precipitate," a game like "rummy," in which cards bearing names and symbols are put together to make compounds; and "Elemento," a chemical variation of "bingo" involving the completion of rows of the Periodic Table. Acquaintance with the first of these would at any rate prevent the repetition of the well-known case where a rheumatic patient found that his pains were relieved by doses of saltpetre, after the nitrate of potash prescribed by his physician had been a complete failure.



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